The FOUNDRY

Volume 57
Number 22

Published
Semimonthly

CLEVELAND, OHIO, NOVEMBER 15, 1929

Castings Provide Memorials To the Honored Dead

THE idea of a monument to mark the resting place of the dead probably originated in ancient Egypt where pyramids, some of enormous size, were built. Each of these memorials contained a room which was used as the royal sepulchre. The great pyramid, built by Khu-fu about 920 B.C., is 764 feet square at the base

A Cast Iron Shell Is Covered With Enamel To Provide A Beautiful Memorial

and 482 feet high. The type of monuments changed slightly with each succeeding generation, and beauty rather than size became the guiding motive. Today, the most beautiful specimens of stone are gathered from the four corners of the world, to be cut into the lasting memorials to the honored dead. From the time of the pyramids until 1929, most monuments have been carved from stone. However, a new type of memorial was exibited at the recent National Metal congress in Cleveland. This consists of a cast gray iron shell skilfully covered with a heavy coating of enamel to represent a marble memorial. Clean cut designs may be cast into the surface of the monument and a cast bronze plate carrying the desired inscription is anchored securely in the top of the memorial to add lasting beauty. When properly anchored in a concrete base, the cast iron marker will withstand the ravages imposed by nature.

Find Where Castings Can Be Sold

CONTENTS

FEATURE ARTICLES

Page

Mold Handling System Speeds Production of Bronze Bearings—By Edwin Bremer 946
Constructs Permanent Molds for Aluminum Castings—By Allen J. Walter 952
British Foundrymen Cast Variety of Alloys—Part II—By Thomas H. Turner 956
Producing Steel Castings in the Modern Foundry—Part XII—By Charles W. Veach 958
Diversity of Product Contributes To Success—By Herbert R. Simonds 961
Steel Founders Plan New Association Activities 969
Mold Planer Side in Floor—By R. H. Palmer 971
Must Educate Foundry Personnel—By J. A. Davies 972
Bill Discusses Seven Cardinal Sins—By Pat Dwyer 973
Training Foremen Presents Important Problem to Industry—By A. B. Pierce 976
Chill Molds Need Dense Structure—By James H. Anderson .. 978

REGULAR DEPARTMENTS

Questions and Answers on Foundry Practice 965
Problems in Nonferrous Founding — By Charles Vickers 968
What Others Are Thinking 979
The Shakeout 980
Comings and Goings of Foundrymen 981
Trade Trends in Tabloid ... 985
What the Foundries Are Doing 986
New Trade Publications ... 986

PUBLISHED BY THE PENTON PUBLISHING CO., CLEVELAND, O.
BRANCH OFFICES

CHICAGO ..... 1347 Peoples Gas Bldg.
CINCINNATI ..... 209 Edwards Bldg.
NEW YORK ..... 2203-2206 No. 220 Broadway
PITTSBURGH ..... 2148-49 Oliver Bldg.
SAN FRANCISCO ..... 24 California Street
WASHINGTON, D. C. ..... 1653 Pennsylvania Avenue
LONDON, ENGLAND ..... 416-417 Caxton House, Westminster, S. W. 1
BIRMINGHAM, ENGLAND ..... 14 New Street
PARIS, FRANCE ..... No. 9 Rue de Londres
BERLIN, GERMANY ..... Dahlmerstrasse 64A, Berlin, Lichterfeld-West

Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico ..... $3.00 a year
Canada ..... $4.00 a year
Great Britain and other Foreign Countries ..... £1:0:0 a year
Single Copies ..... 25 cents

Copies published three months or more previous to date of current issue, 50 cents each.

Member, Audit Bureau of Circulations, Associated Business Papers Inc., National Publishers' Association

The A. B. P. is a nonprofit organization whose members have pledged themselves to a working code of practice in which the interests of the men of American industry, trade and professions are placed first—a code demanding unbiased editorial pages, classified and verified subscribers, and honest advertising of dependable products

Copyright 1929 by the Penton Publishing Co.

Fig. 1—Molds Are Poured by Separate Crews

MOLD

Handling Production of

WHILE machinery makers and engineers are interested vitally in the subject of bearings and are familiar with the characteristics of bearings for different purposes, it is only recently that the man in the street has become conscious that there is such a thing as a bearing. This is due to the advertising and sales campaigns of the various automobile firms which point out to the prospective consumer, the value of the three, five or seven-bearing crankshaft, as the case may be. While mention is made of numerous other bearings and bushings in an automobile the importance of the engine bearings is brought forcibly to the automobile owner's attention if he fails to see that the proper amount of oil is in the crankcase or that the oil is changed when a certain mileage has elapsed.

Although reference is made at various times to other types of bearings, those made completely of bronze and the bronze-back, babbitt-lined type are used more extensively than any others. This applies not only to automobiles but also to other types of machines in which bearings are a necessary part. The position of esteem which bronze bearings have attained is due to their antifrictional qualities and to their ability to withstand severe conditions in service.

Since Detroit is the hub of the automobile industry and produces enough motor cars each day to supply one to every individual in a fair-sized community, it is not surprising that the city contains a number of foundries whose aims are to supply the ever increasing demand for bronze bearings. An outstanding firm engaged in bearing production in Detroit is the Federal-Mogul Corp., which recently moved into its new $300,000 foundry. This new foundry, is the outgrowth of expansion needs and the consolidation

Fig. 2—After the Castings Are Ground, They Are Placed on a Conveyor Which Carries Them to the Inspectors Shown at the Left

By Edwin Bremer

System Speeds Bronze Bearings

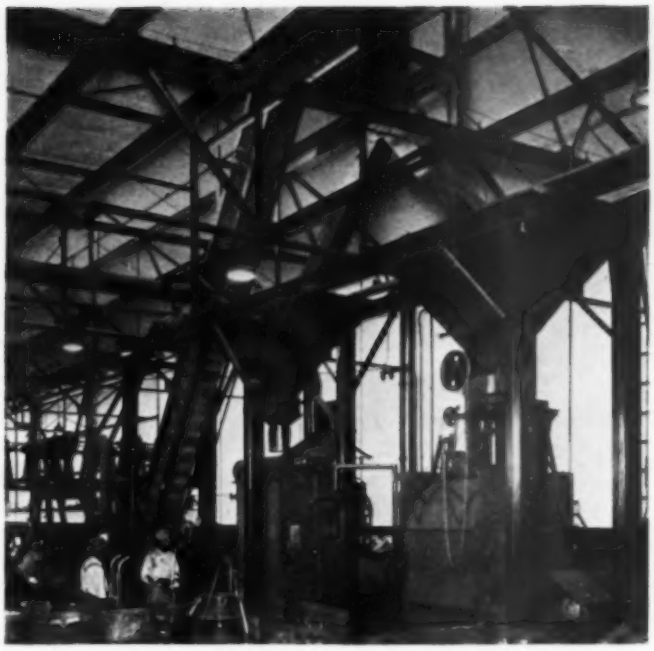


Fig. 4—Overhead Bins Supply Castings for Mills

of two separate plants at one location, giving a total productive area of over 100,000 square feet. In its construction, careful thought was given to provide the best combination of working conditions, arrangement of machines and mechanical aids which would increase production and allow for future expansion.

Metal for the bronze foundry is melted in three special cupolas using a low blast pressure and petroleum coke, 16 pit-type, coke-fired crucible furnaces and two 1000-pound capacity, oil-fired, rotating type furnaces manufactured by the United States Smelting Furnace Co., Bellville, Ill. A view of the cupolas and pit fires is shown in Fig. 5. Each cupola melts about 2500 pounds of metal per hour. The metal charges are sent to the charging floor from the mixture room in sheet iron boxes containing 220 pounds. The low pressure air is supplied at the rate of approximately 350 cubic feet per minute, and the metal to coke ratio is stated to be about 15 to 1.

The cupolas operate continuously and the metal is tapped at approximately 5-minute intervals into 220-pound crucibles suspended from a monorail system by trolleys and chain blocks for raising and lowering the crucibles. Slagholes diametrically opposite the tapholes which are left open during the day's run, permit the small amount of slag formed to run out of the furnace upon the floor. The pit fires are arranged in two rows of 8 furnaces each, and are placed back to back with the chimney flue between them. The fireholes are covered with heavy, concave, cast-iron lids which are counterbalanced so that they may be swung to one side. The lids also are hinged so that they may be swung up and back

Fig. 3—Castings Are Shaken out on a Long Grid Which Allows the Sand to Fall on a Conveyor Belt Leading to Sand Conditioners

Fig. 5—View of the Melting Department Showing Cupolas in the Back and Pit-fires in the Foreground

over the furnace when this is desirable.

Fig. 5 also shows the safety grid-type flooring placed around three sides of the double row of pit fires. This flooring which is about 4 feet wide spans the ash pits and not only offers safe footing for the men at the furnaces, but allows any spilled metal to drop through the openings to the pit below.

Charges for the cupolas and furnaces are weighed carefully in a specially designed mixture room. The permanent metal bins are in rows down the sides of the room, leaving an open central space, for weighing, etc. These are constructed with a steel framework to which the heavy wooden partitions are bolted. The steel members at the front of the bins are rolled T-sections. Six-inch sections of angle iron are riveted on both sides of the web of the T-section upright that extends out from the bin. The angle sections are placed at an angle of approximately 45 degrees, and carry the boards that later form the front of the bin.

Charges Are Checked

Tote boxes, containing the metal charges, are formed of heavy sheet steel and have a capacity of 220 pounds. All metal passing to the melting units is weighed into these boxes and as previously mentioned, the melting and pouring practice is based on 220-pound units. To insure ample separation of the different alloys used and to have an accurate check of the metal going to the furnaces, each box is marked in chalk with the number of the mixture, and contains a card showing the number of the mixture, and the weights of the components such as gates, borings, ingot metal, etc., contained.

Cores used in the foundry of the Federal-Mogul Corp. are made from oil-sand which is blended in a sand mixer supplied by the Blystone Mfg. Co., Cambridge Springs, Pa. The coreroom is situated along one side and end of the building. Fig. 7 shows the core benches and some of the ovens employed in baking the cores. The ovens, six in number, were made by the Foundry Equipment Co., Cleveland, and are coke fired. They are the drawer type and are arranged in two groups; one containing four and the other two ovens.

Cores Stored on Shelves

The core benches are covered with ¼-inch steel plates which form the working space. Small steel hoppers at the back of the benches supply each coremaker with sufficient sand to make a large number of cores without having to wait upon the sand mixing unit. The green cores are turned out on flat, steel drying plates and then placed in the ovens. After a suitable baking period determined by the size of the core, they are removed from the ovens and placed on steel shelving which forms storage racks. As the cores are required in the foundry, they are taken from the shelves.

Machine and hand molding are practiced at the Federal-Mogul foundry with the greatest bulk of the work being turned out by 14 machine molders who place their molds on a continuous mold conveyor supplied by the Osborn Mfg. Co., Cleveland. Hand molding is practiced only on the 4 floors where all experimental and odd jobs are made. This work will be described later.

Use Mold Handling System

Views of the continuous mold conveyor are shown in Figs. 1, 3, and 9. Fig. 3 shows the shakeout side of the machine while Fig. 9 is taken close to the molding stations and shows the sand hoppers and the molding machines on the outside of the conveyor. Pouring is depicted in Fig. 1. The continuous mold conveyor is about 23 feet wide and 160 feet long. Molds are conveyed on large steel plates about 4 feet wide and 8 feet long. These plates are connected closely, the end of one being cut convex and the end of the other plate being concave. This construction allows a practically continuous steel platform on the straightaway sides, and affords articulation so that the plates may be turned at the semicircular ends. The plates are supported by wide rimmed wheels which travel on a wide track. A continuous, motor-driven chain, propels the conveyor.

As previously stated, 14 molders and machines supply the molds which are placed on the conveyor. Seven of the machines are placed on the outside of the conveyor and seven on the inside. Machines used are the jolt-squeeze type with pattern draw made by the Osborn company. Each molder lays down six molds on each

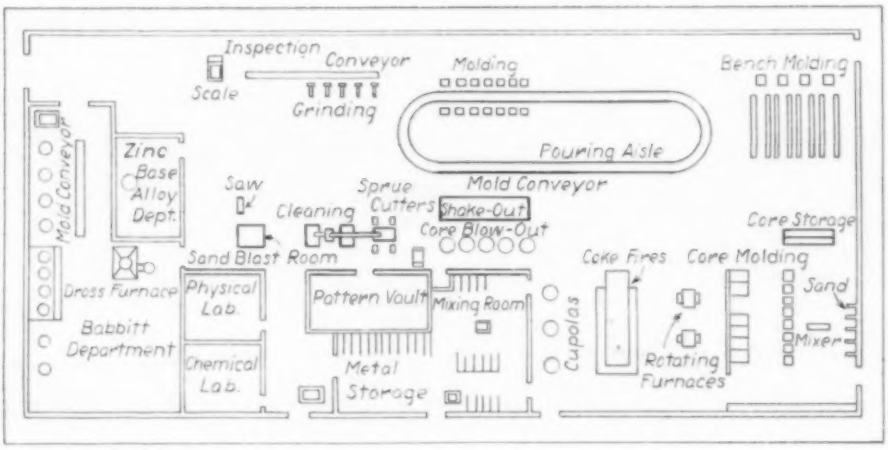


Fig. 6—Sketch Showing the Arrangement and Location of the Various Units and Departments

plate and then places a second stack of the same number on top with a slight setback so that the first row may be poured without interfering with the second row. Since the molders work at approximately the same speed, the plates are all filled at the same time. When they are filled, the conveyor is put in motion so that seven plates containing empty flasks are set opposite the respective molding stations.

Movement Is Intermittent

This intermittent motion continues and the molds reach the pouring station where they are poured by one of several pouring crews as shown in Fig. 1. Following the usual practice in pouring molds stacked two-high, the lower row is poured first so that no spills or splashes of metal or dirt fall into the gates of the lower row. Pouring and molding are synchronized so that the pouring operation is completed before the conveyor receives its next intermittent motion. This synchronization also allows the molds all to be poured in a definite location and this is only a short distance from the melting units. Consequently, there is little delay after tapping and the metal is poured at the proper temperature.

From the pouring station, the molds are advanced periodically and reach the shakeout. As may be seen in Fig. 3 the shakeout consists of a steel hopper raised about 18 inches above the floor level. This hopper is about 60 feet long, 3 feet wide, and the top is formed of steel bars which make a grid.

Four shakeout men working in pairs lift the molds from the conveyor and dump them out on the grid. The sand falls through the openings upon a conveyor belt which carries it to conditioning apparatus, and the castings remain on the grid. The shakeout men pile the empty flasks, bottom boards, and separating plates on the conveyor. Another crew of five men provided with short hooks pick up the castings attached to their sprues and runners, and immerse them in wooden barrels full of water. Five barrels are placed in drain pits about one foot deep, and are kept full of running water. Immersion of the hot castings in the cold water causes the evolution of large volumes of steam which blows the core from the casting and removes the slight amount of sand adhering to the surface.

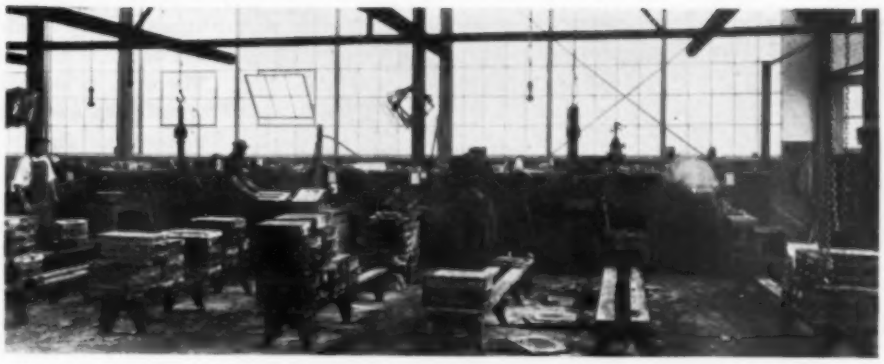


Fig. 8—Four Bench Floors Are Used to Produce Experimental Castings and for Odd Jobs

Castings Placed in Hopper

After the cores are blown out, the castings are piled on trucks and transported to the cleaning department which is just above and to one side of the mold conveying machine. Sprues on the production bearings are removed on four sprue cutting machines supplied by the Tessmer Machine & Tool Co., Detroit. Two of these machines are placed on either side of a steel hopper whose upper opening is level with the floor. The lower mouth of the hopper opens on a bucket-type conveyor belt which rises steeply toward the roof as shown in Fig. 4.

As the men remove the sprues from the castings, they drop the castings into the hopper. The castings fall on the belt and are raised approximately 30 feet where they drop into a large steel hopper which has two outlets. Flow of material through either of the outlets is controlled by a flap gate controlled from the floor. The outlet chutes from the bin under the roof lead to two steel bins or storage hoppers about 10 feet below. These bins are located just above two sandblast barrels supplied by the Pangborn Corp., Hagerstown, Md. The location of the bins and sandblast barrels is shown clearly in Fig. 4. While at present all features of the storage bins and sandblast barrels are not completed, flexible, jointed steel pipes will be attached to the discharge spouts of the two bins immediately above the sandblast barrels so that the castings may be dumped directly into the barrels without intermediate handling.

When the castings have been sandblasted to the desired finish, they are placed in boxes or in barrels, transported to the grinding department which is located almost directly across the room from the cleaning division. Fig. 2 gives an excellent view of the arrangement of the grinding department which contains one single row of five double-stand grinders made by Kling Bros. Engineering Works, Chicago. Steel chutes between each pair of wheels supply castings to the grinders.

Work Is Inspected

After the castings are ground, they are placed on a pan-type conveyor supplied by the Palmer-Bee Co., Detroit, which passes directly behind the grinding stands. The conveyor carries the castings from the grinders to the inspectors nearby. The inspectors discard the defective castings and place the good castings in separate boxes according to the various types made and mixtures used. The boxes then are forwarded to the machining department for broaching, etc.

Mention was made previously of the bench or hand floors on which the experimental and odd castings are made. These are four in number and are located beyond the end of the

Fig. 7—Drawer Type Ovens Are Employed to Bake the Small Cores Used

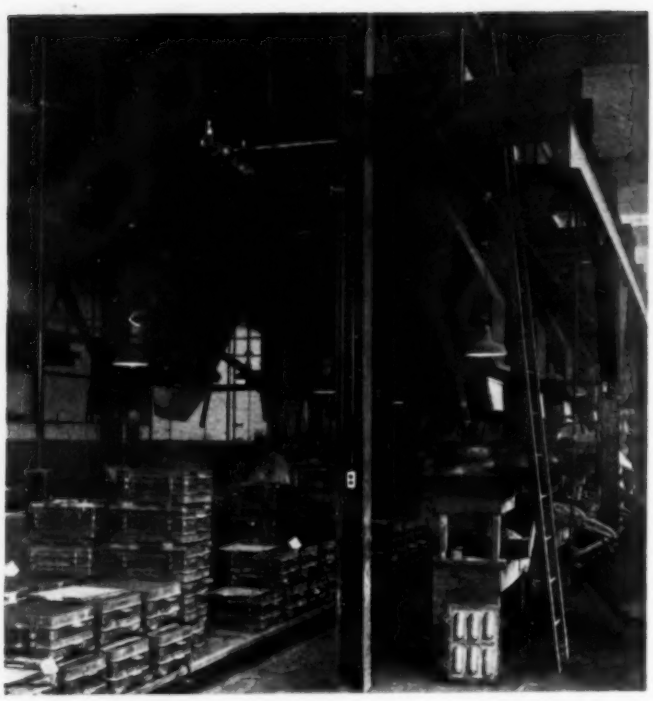


Fig. 9—View Along One Side of the Mold Conveyor

mold conveying machine which has been described. While the practice employed on these floors is similar to that in general use, it may be of interest to describe the molding of several castings as followed on the bench floors of this foundry which are shown in Fig. 8. The first mold described is that shown in Fig. 10. The casting is a cored bushing about 12 inches long, 2½ inches in diameter with a wall thickness of about ¾ inch.

Drag Is Rolled Over

The cope flask is placed on the bench and the pattern set in the proper position. Then the drag flask is placed on the pattern and rammed up. After striking off some loose sand is scattered over the surface and a bottom board carefully rubbed into position. The two molds and bottom board are rolled over and the cope is rammed. The cope is struck off and removed with assistance of a vibrator attached to the pattern plate. The molder then finishes the cope half of the mold which has been placed to one side of the bench and cuts the branch gates leading from the runner to the castings. The mold is dusted carefully with graphite, and the excess blown off. Then the mold surface is floured, the excess blown off and the molder inserts the strainer core in the sprue. The strainer core is held in place by three small nails.

After finishing the cope, the molder turns his attention to the drag. He removes the pattern, cuts the branch gates to the castings and enlarges the runner at the sprue end to form a small basin which will be under the strainer core when the mold is closed. The drag is dusted with graphite and floured as in the case of the cope, and with its bottom board is placed upon the mold rack on the floor. The cores then are set and the mold is closed. Another interesting job is a heavy cored bushing about 20 inches long, 6 inches in diameter and a wall thickness of 1¾ inches. This is cast vertically in a 5-part flask. The sprue, instead of dropping straight to the bottom, is offset as shown at *C* in Fig. 11. In other words the sprue looks like a crankshaft with three throws in line. A double branch gate to the casting is cut from the sprue in the drag flask, and single branch gates in the two cheek flasks immediately above.

Contains Two Flanges

A third cored casting about 12 inches long and 8 inches in diameter with a 1½-inch wall has two flanges. One flange is at the end and the other is about 2 inches from the other end as shown at A in Fig. 11. *A* deep groove is in the center and a heavy projection extends at right angles to the main body of the casting at the end where the flange is set back from the end of the casting. This casting is molded horizontally with the heavy projection extending through the cope. A strainer core is placed at the bottom of the vertical sprue. A heavy runner leads from the sprue and joins the casting along the edge of the flange. One production job on the molding machines uses 4 half patterns mounted on a plate, as in *B* in Fig. 11. The runner from the sprue ends in a blind riser placed in the center of the space left between the ends of the patterns. Small branch gates set angularly open into the adjacent flanges of the castings.

Manufacture White Metals

In addition to its foundry, the Federal-Mogul Corp. manufactures babbitt metal and zinc base alloys. Some of these alloys are used in its own plant for lining bearings, producing all babbitt bearings and in the die casting division. They also are sold in ingot form to consumers of this type of alloys. Babbitt metal is produced in a separate department adjoining the foundry. This department contains six, 4000-pound capacity, coke-fired furnaces and four crucible, coke-fired, pit-type furnaces for melting copper for alloying purposes.

Metal from the furnaces is poured into 35-pound ingots which are cast on an ingot mold conveyor. The conveyor was supplied by the Palmer-

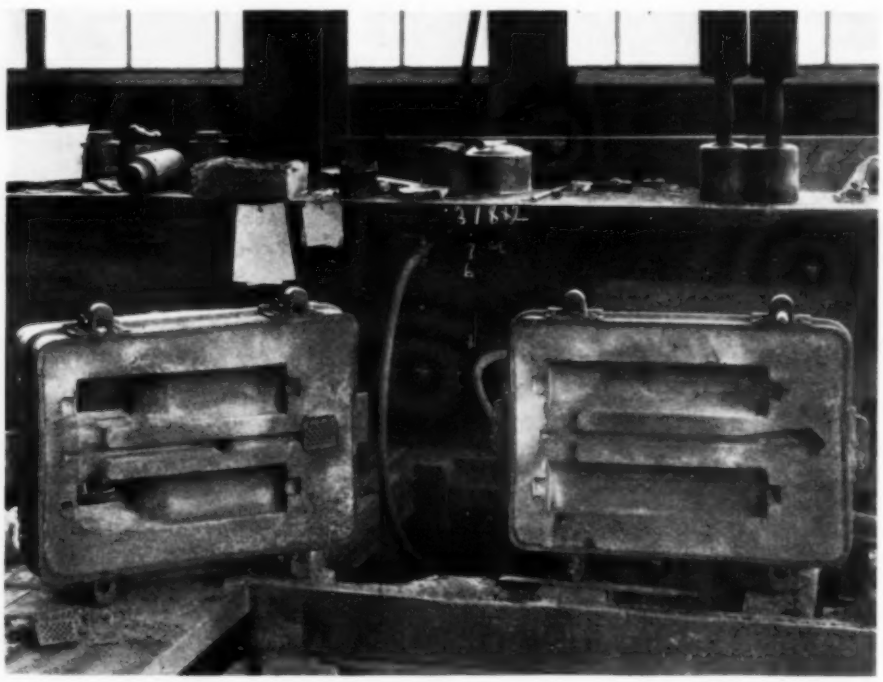


Fig. 10—Cope and Drag Molds for a Cored Casting with Heavy Projection at One End as May Be Observed at the Left

Bee Co., Detroit, and is approximately 40 feet long. It is situated close to the melting units and the driving mechanism is reversible so that the conveyor may be run forward or backward. This arrangement was made so that sufficient cooling could be given to the ingots according to whether the molten metal was taken from the first furnace or the fourth one.

This department also contains an oil-fired hearth furnace in which babbitt drosses are smelted. The hearth of the furnace is approximately square and has a hearth area of 40 square feet. It is fired by two oil burners situated in opposite walls of the furnace. Zinc-base white metals are compounded in a separate department adjoining the babbitt division. The metal is melted in a coke-fired, pot-type furnace with a capacity of 4000 pounds. Adjoining this department are the chemical and physical laboratories which are housed in separate rooms. These departments carry on the regular routine examination of the product turned out each day, and also carry on investigation and research.

Book Review

Handbuch der Eisen-und Stahlgiesserei, Part III, Schmelzen, Nacharbeiten und Nebenbetriebe, edited by C. Geiger, imitation leather, 747 pages, 7½ x 11 inches, published by Julius Springer, Berlin, Germany, and supplied by THE FOUNDRY, Cleveland, for $17.50 plus 15 cents postage, and in London by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, for £3 7s 0, postage extra.

This is the second edition of the third volume of a series of books dealing with all phases of ferrous founding. This volume covers the melting of cast iron and steel in the crucible, cupola, the reverberatory or air furnace, open hearth, small bessemer converter and the electric furnace. Production of malleable cast iron, cleaning castings, surface treatment and improvement of cast iron, heat treatment of steel castings, welding of steel and gray iron castings, preparation and mixing of molding sand, and patterns also are discussed. Authors who contributed sections to the book are C. Irresberger, E. Schuez, C. Schwarz, Max Escher, Karl Dornhecker, Rudolf Stotz, U. Lohse, Franz Maertens, H. Witte, Alfred Widmaier and Leonard Treuheit. Each section describes in detail all phases connected with the subject. For example the first section relating to melting in the crucible describes crucible furnaces for solid fuel, gaseous fuel and electricity; gives the efficiency of the various methods of crucible heating; describes the typical crucibles; gives general works rules; describes the melting of steel and iron, and the production of important alloys in the crucible. Melting in the noncrucible furnace; furnace building, and burners and burner control also are described. Another feature of value is the bibliography of literature on the subject which follows each section. Numerous illustrations, diagrams and tables assist the reader in following the text matter. A subject index and a name index conclude the volume.

Steel Casting Bureau Holds Meeting

Steel Casting Development bureau recently held a two day meeting at the Greenbriar hotel, White Sulphur Springs, W. Va. The first session was devoted to regular business and the consideration of a report on the recent convention of the American Society for Steel Treating. Papers on the special elements of foundry practice alloted to individual foundries for research featured the second session. These papers covered matters of molding technique such as sands, skin drying of molds, use of nails and chills, core dressing, etc.

Full membership of the society was represented. Those in attendance were: G. K. Casey, Treadwell Engineering Co., Easton, Pa.; Newlin T. Booth, Deemer Steel Casting Co., New Castle, Del.; Chester S. Roberts, Dodge Steel Co., Philadelphia; Clarence Tolan, Dodge Steel Co., Philadelphia; J. S. Kinne, Riverside Steel Casting Co., Kearny, N. J.; H. C. H. Cunningham and H. Cunningham, Crucible Steel Casting Co., Lansdowne, Pa., E. B. Powell, Atlantic Steel Casting Co., Chester, Pa.; E. M. Schumo, Pennsylvania Electric Steel Casting Co., Hamburg, Pa.; Frank Hodson, Empire Steel Casting Co., Reading, Pa.; and George Batty, technical director of the society.

The bureau will have a display of its products at the American Road Builders convention which will be held in Atlantic City, N. J., in January.

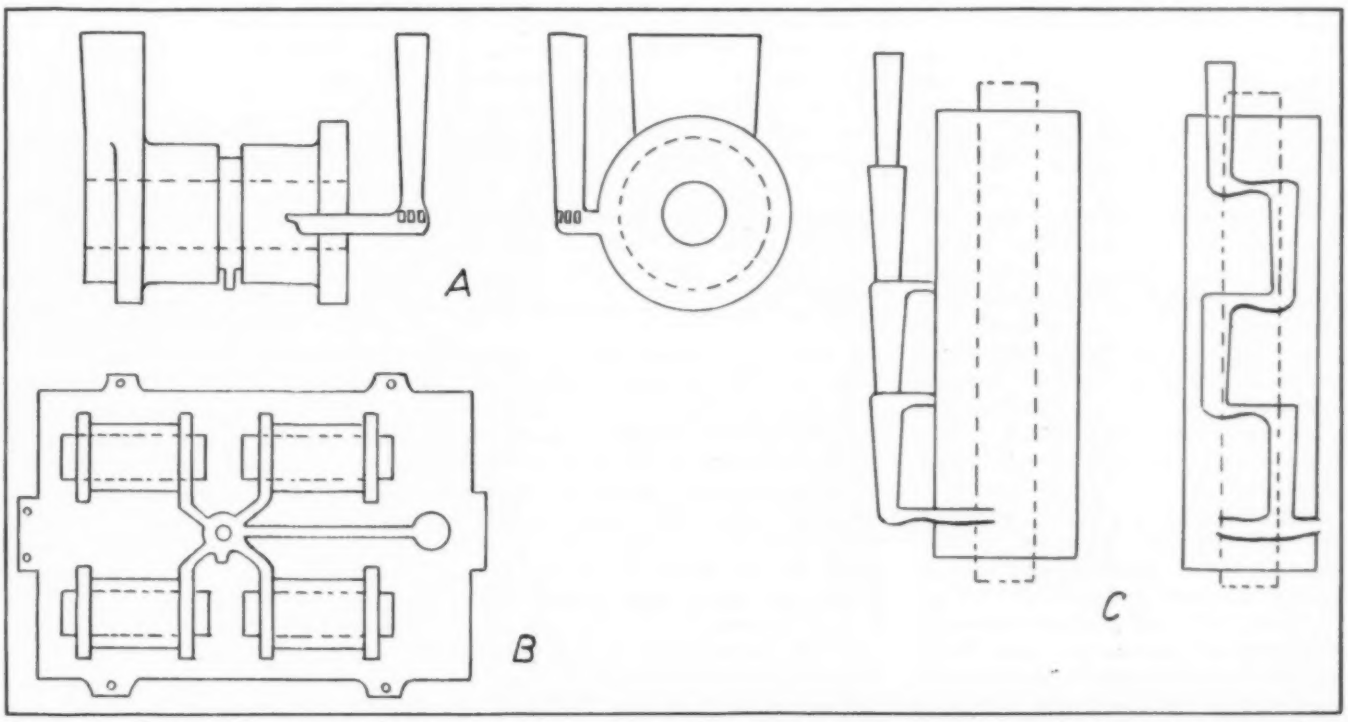


Fig. 11—Sketches Showing Methods of Gating. A Is Casting Made Horizontally. B Is Mounted Pattern Plate, and C Is Two Views of a Bushing Cast Vertically

Constructs Permanent Molds for Aluminum Castings

BY ALLEN J. WALTER

DURING the past few years considerable interest has been manifested in the production of aluminum castings by the non-pressure die or permanent mold process. The amount of available data on the subject has been comparatively meager up to the present. This may be accounted for, to a great extent, by the fact that those few manufacturers who have developed the process to a successful and highly remunerative point, have done so only after laborious research, the outlay of considerable sums of money and in the face of innumerable difficulties and disappointments.

The idea of permanent mold casting has made an alluring appeal not only to the larger producers but to many of the smaller nonferrous foundries. The majority of those who have tried that method of production have abandoned the project after bitter contact with it.

Tells Advantages

However, once a manufacturer has solved the problem of producing his aluminum parts in permanent molds, his success is phenomenal. The amount and quality of production which can be achieved at minimum cost is almost unbelievable to the uninitiated. Not only are molding costs greatly reduced but in many instances machining and finishing costs become almost negligible. Permanent mold products readily can be cast within a tolerance of .008 of an inch and intricate core work can be embodied within the same limitations. Necessity of machine work frequently is eliminated entirely.

There is little ground for comparison between the product of the permanent mold and the sand casting. Permanent mold castings are from ten to twenty per cent stronger and show a much closer grained and more homogeneous structure while their smooth, even surface texture stands in marked contrast to the comparatively rough, gritty surface of sand castings. Where grinding and polishing is a consideration, a good permanent mold casting will eliminate at least one and often two wheels. Common labor is substituted for skilled molders. Almost any inexperienced laborer of ordinary intelligence can be taught to operate a permanent mold within a few hours under a competent instructor. Within a few days that same unskilled laborer can often produce five or six pieces to one produced by the most skillful and speedy sand molder. What is more noteworthy is that his castings will be superior to the product of the skilled craftsman.

When considering the best method for producing a given aluminum casting, it must be remembered that the application of permanent molds has distinct economic and physical limitations beyond which their application is either inadvisable or impracticable. The sand casting process still holds an impregnable position for certain types of work and pressure die casting is suited for some parts beyond the field of non-pressure or permanent mold casting.

For example, where production of a given casting is limited to only a few pieces or where the casting is subject to frequent change of design, the cost of putting the job on a permanent mold basis would be prohibitive. In the case of small castings, where several dozen can be gated on a single match plate and where neither close dimensions nor quality of finish are factors, the sand casting method is frequently the most economical. Moreover, comparatively large and weighty castings present an impediment to the permanent mold process.

Application Is Limited

Generally speaking, any attempt to cast an aluminum part exceeding ten pounds in weight is likely to involve extreme difficulty in permanent molding. Extensive areas of thin section less than ⅛-inch thick had best be avoided. The reproduction of delicate fancy work such as engraving, scrolls, etc., found on interior automotive hardware and similar products are unsuited as much for permanent mold production as they are for sand casting. Pressure die casting is the proper field for such production as is also the case where thin sections and extremely sharp or knife-like edges must be produced. With the exception of the above mentioned limitations, almost any type of aluminum casting may be produced successfully in permanent molds of the non-pressure type.

Certain general principles, applicable to all permanent mold castings may be set forth, but it must be remembered that no two problems are

Corrects Defects

AFTER a permanent mold of the non-pressure type has been made, much work remains to be done to correct defects in castings manufactured from it. In this article, the author describes the construction of that type mold and tells how some of the defects encountered in making permanent mold aluminum castings are overcome. The author received his education in the schools of Mansfield, O., and later at St. Vincent college, Latrobe, Pa., and at the Catholic University of America, Washington. He joined the army on America's entrance into the war and studied roentgenology and the physical and mechanical structure of X-ray machines. He served with the American army in France and at the close of the war returned to this country to do research in the field of dry heat. He now is interested in permanent molds and has devoted several years of research to that field.

exactly alike. Each type of casting presents a particular problem. The fabrication of suitable materials into dies or molds, properly designed for production is worthy of careful consideration.

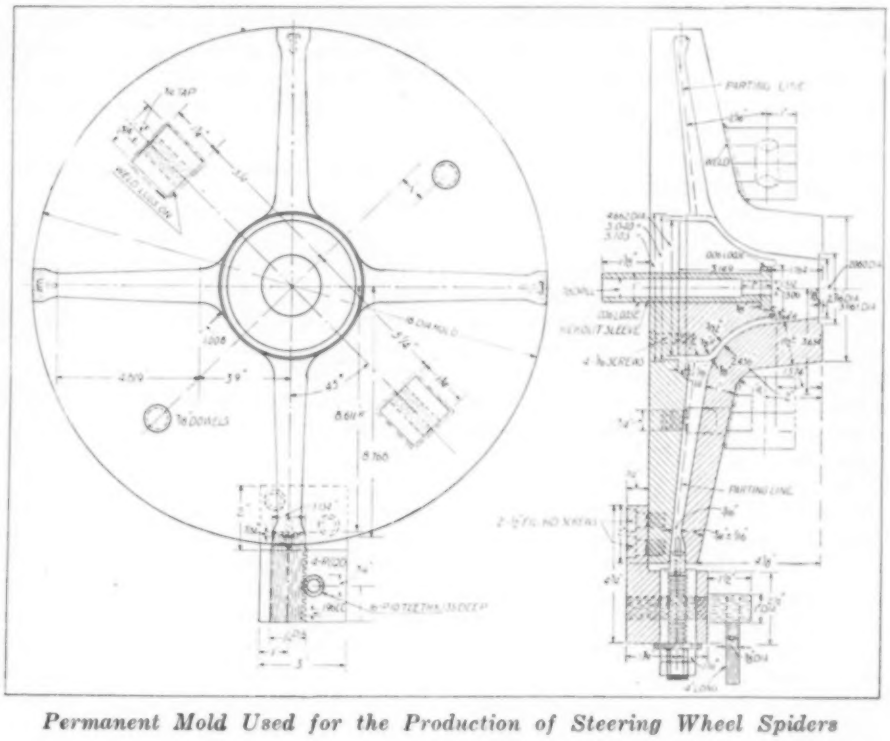
High grade cast iron having a chilled surface possesses certain advantages over steel for permanent mold construction. Both economy of construction and physical properties enter into these considerations. Where cast iron is used, it is important that the casting be properly heat treated before it is turned over to the die makers. The object of this heat treatment is to relieve the casting of such stress and strain as would otherwise tend to cause trouble when the mold is subjected to sudden heating and chilling in production.

Gives Mold Thickness

Regardless of whether cast iron or steel is used, the thickness of the stock in both halves of the mold, immediately adjacent to the entire casting cavity, should be four times the thickness of the corresponding part of the aluminum casting to be produced. For instance, let us assume that an aluminum steering wheel spider is to be made and that the arms of the spider are ⅝-inch thick at a point two inches from the juncture of the hub and the arms. In a properly designed mold, the thickness of the iron or steel in each half of the mold immediately adjacent to this point, would be 2½ inches. The thickness of the stock in each half of the mold should taper in exactly the same proportion as the thickness of the arm. This four to one mold thickness should be carried out only at points immediately adjacent to the casting cavities. If it is desirable to cut down on the gross weight of molds, that ratio readily may be retained by casting the extra stock in the form of a raise or hump over the casting cavities. Dimensions of other parts of the mold may be made as thin as consistent with maintenance of adequate structural strength for the entire unit.

If the mold designer plans to maintain the proper thickness over the casting cavities by means of the suggested raises or humps, too strong emphasis can not be placed on the importance of making these humps integral parts of the mold casting. They should be provided for in the pattern from which the iron mold casting is produced and should be made with the original casting. The office of the four to one thickness of the mold is to provide adequate chilling qualities when aluminum is poured into the mold. The mold must be of the correct dimensions when it is made. Any attempt to remedy a deficiency of thickness in the initial design by welding or brazing on extra stock almost is invariably foredoomed to failure. The extreme importance of maintaining the previously mentioned thickness ratio over all casting cavities will become apparent later in this article.

Once the mold casting is ready for the die makers, the sinking of the cavities and general construction does not differ from the usual procedure in making rubber, bakelite or similar molds. The shrinkage allowance in permanent mold construction should be .008 inch per inch. The most suitable place for parting and the most convenient method of opening and closing, removing cores and ejecting castings from the mold must be determined from the nature of the casting.



Permanent Mold Used for the Production of Steering Wheel Spiders

While no fixed and fast rules are available for locating gates, it generally is best to gate the casting as low as possible so that the air will be forced out as the metal rises in the mold. Gates first should be made relatively small. It always is easy to enlarge them if the first use of the mold indicates the necessity. Wide, thin gates generally are preferable to narrow thick ones. Whenever possible, the sprue should be located so close to the casting that the simple expedient of breaking the sprue as the metal gives the first indication of setting, will eliminate the necessity of sawing off the gate. If any part of the casting requires machining, that is the logical place to locate the gate and sprue unless the danger of trapping air makes it impracticable. The best size and type of sprue for a given job usually is a cut and try proposition. The use of risers in permanent mold work is not extensive and they should be employed only as a last resort.

Movable cores are most practicable if made of steel. Where the core extends entirely through the casting, as in the hub of a steering wheel spider, a knock-out hammer under the molding table serves to eject the core. When the cores do not extend entirely through the casting, as the screw hole cores at the ends of steering wheel spider arms, a rack and pinion or eccentric lever device will frequently serve to remove them. In cases where back draft or bellies in the casting will not permit the removal of a solid core, a simple, collapsible steel core may solve the problem. Anything beyond the most simple cores of that type are to be avoided. Even the least complicated of these cores have a tendency to refuse to collapse at the right time. The simple expedient of inserting an ordinary sand core usually gives the best results.

Where the core is not intended for removal, it is made either an integral part of the mold or is machined separately from a piece of cast iron. It is held in place by cap screws or such other means as circumstance may indicate as most suitable. Whenever practicable, it is better to machine the permanent cores and set them on the mold because an allowance of .003 or .004 inch where they are attached to the mold often will serve as an ex-

cellent vent for the escape of air and gas. The illustration shows working drawings for a permanent mold used for the production of steering wheel spiders. In this particular mold it may be noted that the designer did not adhere to the exact four to one stock thickness. This was due to an exceptional reason.

Coats the Molds

Permanent molds always should be carefully coated before molten metal is poured into them. This coating should be renewed for every four or five hundred castings produced. Sometimes it is necessary to recoat them oftener. Coating the molds serves a three fold purpose. It prevents the aluminum from adhering to the iron or steel, it serves to keep the surface of the casting smooth and it not infrequently plays an important part in holding up shrinkage.

Various kinds of mold coating are used by different manufacturers. Zirconium clay, mixed to the consistency of thin paint is one of the most common. Extensive experimentation would tend to indicate the superiority of a good grade of iron oxide for the purpose. The iron oxide is mixed to the same consistency as the clay using water as a binder. This coating usually is applied with a spray gun when the mold is cool. Movable cores and parts subjected to friction or abrasion should be coated with a thin film of powdered or flake graphite. However, with the exception of cores and points subjected to friction, graphite should be avoided as it has a tendency to blister the casting. That especially is true when it is applied over extensive areas of the mold.

The choice of an alloy is determined either by the physical requirements of the casting or is limited by the specifications of the customer. Alloys containing from three per cent to as high as fourteen per cent silicon are excellent for permanent mold production. The experienced permanent mold foundry will avoid most diligently any aluminum alloy containing as much as 1½ per cent of either iron or zinc. Where aluminum clippings are used, care must be taken to avoid any clippings containing manganese. Iron, zinc or manganese in the presence of aluminum can create more trouble in a permanent mold foundry in one hour than can be rectified in a week.

There are numerous alloys well suited for permanent mold work. Two excellent alloys are made as follows: Silicon, 5 per cent plus or minus 1 per cent; copper, 4 per cent plus or minus 1 per cent; impurities, 1½ per cent, maximum; balance aluminum; the other contains nickel, 4 per cent plus or minus 1 per cent; copper, 3 per cent plus or minus 1 per cent; silicon, 4 per cent plus or minus 1 per cent; impurities, 1½ per cent, maximum; balance aluminum.

Good results are obtained with No. 12 remelt provided the alloy is reasonably free from zinc and iron. When the foundry is not held to a specific analysis and cost of material is a factor, crank cases and other good, clean scrap, properly sweetened with virgin metal and a rich silicon-aluminum alloy, frequently will give surprisingly good results. The uninitiated and those not adequately equipped to mix and analyze their own alloys will do well to confine their activities to the production of castings and leave the mixture of metal to some reliable source of known dependability.

Gives Pouring Temperatures

The lowest temperature at which the aluminum will flow readily, is usually the best temperature for pouring permanent mold castings. As a general rule, this temperature will be found to range between 1250 and 1350 degrees Fahr. However, the author has experienced instances where good castings could not be produced with a pouring temperature under 1500 degrees Fahr.

Before attempting to pour a casting, the mold should be preheated to about 800 degrees Fahr. That applies to sprues and cores as well. Efficient gas burners or bayonet type electric heaters are suited for the purpose. An acetylene torch played over the mold often will prove helpful. The operator should see that the entire mold is evenly heated so as to avoid warping. He should also be sure that the mold is clamped securely before molten metal is introduced.

The best method of pouring any given casting, whether fast or slow, can be determined only by actual experience. Metal should enter the mold in an uninterrupted stream. One or two *freeze ups* will teach the operator the vital necessity of quick action when starting a mold. No attention whatever should be given the first dozen or eighteen castings. Generally the sole utility of these will be confined to bringing the mold up to the proper temperature.

During this period the operator will do well to give his exclusive attention to getting the metal into and the castings out of the mold with the utmost speed. He should be careful to see that all movable cores are in place before pouring. To avoid a freeze up, the sprues should be broken the instant the metal begins to show signs of setting. Movable cores should be withdrawn in quick sequence, the mold opened and the casting ejected. The slightest procrastination in this sequence invariably will necessitate the copious introduction of crow bars, chisels, hack saws and other impedimenta entirely extraneous to the well ordered production of castings. In such extremities the aforementioned acetylene torch probably will be found more efficacious than fervent quotation of scriptural *excerpta*.

The following procedure will be found useful when trying out a new mold. After the first dozen or eighteen castings have been poured in quick succession and the operator is satisfied that the mold has attained its maximum temperature, the mold should be shut down and a careful study made of the last few castings produced. More frequently than not, these will present a sorry looking mess to the uninitiated. Shrinks, cracks, holes and distortions of every conceivable nature probably will meet his troubled gaze.

Having segregated the various defects their cause and remedy can be determined readily. Taking up the study of holes, the mold designer at once will differentiate between those caused by misruns or cold shuts and those caused by air or gas pockets. The first type will indicate clearly that the mold was not up to proper temperature, that the metal was not sufficiently hot or that the gate should be enlarged. Any one of these and possibly a combination of all three may be the cause of the trouble. The remedies indicated are self evident and their application should be made one at a time, reserving the enlargement of the gate until last.

Studies Defects

Holes caused by entrapped air or gas are distinguished readily. The remedy is to be found either in the method of pouring or in the proper insertion of suitable vents, most probably in both. It rarely is advisable to attempt to vent the mold when it is being built. Venting should be reserved until after the first try-out when their number and proper location is no longer a matter of guess. Venting an air pocket sometimes is analogous to placing one's finger on a globule of mercury. It is sometimes necessary to chase an air pocket over half the mold before it finally can be trapped. A whole series of vents may be necessary. Venting may be accomplished by drilling a hole through the mold and then plugging it with a piece of drill rod filed flat on four sides.

Care must be taken that the filed sides do not leave an opening of

more than .003 or .004 inch. Such an opening is sufficient to permit the ecape of air but small enough that the molten metal will not plug the vent. The size of the drill rod will be governed by the size of the cavity to be vented. The inner end of the drill rod should be dressed down to conform with the contour of the cavity while the other end should project a half inch or more beyond the back of the mold to facilitate removal for cleaning. Care must be exercised in seeing that vents do not become plugged. They should be blown out with an air gun at frequent intervals. This should be done after the mold has been coated freshly.

The presence of checks or cracks in permanent mold castings often are due to causes extraneous to faulty structure of the mold as regards thermal design. Investigation frequently will disclose the fact that the cracks are due to some mechanical defect. Insufficient draft may cause the casting to adhere to some part of the mold so that the necessity of undue stress in opening the mold will superinduce a cracked casting. The seat of the trouble may be found in a faulty ejecting device. If mechanical defects can be eliminated, the investigator should make a careful check of the metal analysis, making certain that no appreciable amount of iron, zinc or other impurity is present.

Frequently a decrease and sometimes an increase in temperature will stop a crack. If the analysis of the metal will permit, the addition of some virgin aluminum or of rich silicon-aluminum alloy to increase the silicon content by one or two per cent will be found beneficial.

Corrects Thermal Conditions

If the foregoing suggestions have been followed without success, it is safe to assume that the seat of the trouble has been narrowed down to faulty thermal conditions in the structure of the mold. The cracks undoubtedly are due to an excessive chilling of the casting. When mold design was discussed earlier in this article, it will be remembered that particular emphasis was placed on the necessity of making each half of the mold four times as thick as the casting to be produced. When such is the case, it is always easy to machine off a little stock. If the mold is too thin to give sufficient chill, the defect would present a more baffling problem. When the casting is subjected to excessive chilling, the mold should be put in a shaper, miller or other suitable machine and a little stock machined off at a point immediately over the place the crack appears in the casting. This is an operation calling for extreme caution. The removal of too much stock would be disastrous. Sometimes only .015 or .020 inch of stock need be removed; again it may become necessary to remove as much as an inch. In this connection, the size of the crack, whether large or merely a small surface check, will guide the experienced designer. However, sound judgment would dictate the advisability of taking a succession of shallow cuts until the proper results are obtained rather than running the risk of ruining a costly mold at one fell swoop.

So many factors enter into a discussion of the best methods for holding up shrinkage in permanent mold castings that space will permit consideration of only the more common methods. The vital necessity of guarding against iron and zinc in quantities exceeding 1½ per cent as potent causes of shrinkage as well as other troubles, need not be reiterated. Lowering the temperature of the mold by turning off gas or electric heaters may do away with the shrink. Excessive temperature of the metal is no less frequently the cause of shrinks in permanent mold work than in other type of casting. However, it is a paradox that increasing the temperature sometimes will cure the shrink. Enlarging the sprue or gate may be the answer.

Eliminates Shrinks

If the shrink persists after the above suggestions have been tried, the operator should take a piece of emery cloth or a wire brush and remove all the mold coating at that spot where the shrink appears to form a metal to metal contact. It often is surprising what the removal of a small area of coating will accomplish. If that fails, it will be necessary to resort to thermal compensation in the mold itself. This is done by machining off the necessary amount of stock from the back of the mold, beginning at a point about an inch removed from that at which the shrink appears. Extreme caution must be exercised not to remove too much stock otherwise one will likely succeed only in changing the location of the shrink, or worse still, two shrinks in place of one may be the reward of excessive machining. Whenever a shrink appears in the vicinity of removable cores, chilling the cores in water will usually solve the difficulty.

If the mold has been properly constructed, the application of one or a combination of the above mentioned remedies almost invariably will eliminate shrinkage trouble. If not, it is an almost certain indication that the mold is too thin at the point where the shrink persists. Any attempt to weld or braze extra chilling stock on the back of the mold is a waste of time and energy as previously indicated. However, nine chances out of ten, the following procedure will save the mold. Cut a hole through the mold at the point where the shrink appears. This should be slightly larger than the shrink itself. Plug it with a copper rod or bar one end of which should be dressed down so that, allowing for expansion of the copper when heated, it will conform to the contour of the casting cavity.

Uses Sheet Copper Fins

The other end of the copper rod should extend about three inches beyond the surface of the mold. The protruding end of the copper should be notched with saw cuts to accept 16-gage, sheet-copper fins. These fins should have an area of between 6 and 8 square inches each and they should be spaced about ¼-inch apart. Obviously their number will be determined by the size of the copper rod used. Whenever the mold cavities are sprayed, care must be taken to remove the coating from the copper chills. Fortunately, aluminum poured into the mold will not attack copper inserts rapidly. However, they probably will have to be renewed or dressed down for every five or six thousand castings produced.

For permanent mold work the use of gas or oil fired furnaces combine utility with economy. Electric holding furnaces are superior in localities that afford cheap electric power. Iron pots of 250 to 300 pounds capacity are commonly used. Before putting an iron pot into service, it should be whitewashed or coated with zirconium clay. This is done to prevent the metal from absorbing iron from the pot. Aluminum, especially in the presence of silicon and at high temperatures, will pick up iron quite rapidly.

Care should be taken not to *soak* the metal by re-heating day after day. Pouring should be so arranged that the pots will be completely empty at the end of each day. If any remains, it should be pigged and the next day's run started with fresh metal. Pigs remaining from the previous day may be fed in gradually without detriment. In conformity with best practice the pots not only should be emptied at the end of each day, but they also should be carefully scraped down and given a fresh coat of whitewash or zirconium clay. The life of pots will be enhanced appreciably by giving them a quarter turn daily.

Pouring metal should be kept clean

(*Concluded on Page* 964)

British Foundrymen Cast Variety of Alloys

Part II—Steel

By Thomas H. Turner

GREAT progress has been made in recent years in the casting of large and intricate steel shapes. In America, for example, locomotive frames have been cast for modern giant main line engines, in one piece—both sides, cross-members and cylinders, all forming one casting—and in many cases these have been cast in low nickel, or other slightly alloyed steel, and later heat treated.

No corresponding developments have taken place in Great Britain in this connection, because British locomotive designers employ frames built up from rolled plates or sections. Therefore, it is probably true to say, that high tensile alloy steel castings are seldom made in Great Britain, despite the fact that nickel, nickel-chromium, and other such alloy steel forgings, play essential parts in modern engineering practice.

Not Widely Used

Heat treated alloy steel castings may be used in the future, but they are not widely used now. Government engineers recently suggested that the British foundry industry was backward as regards steel castings. This may be true, but in view of the outstanding merit of the joint research work on steel ingots recently published by British steelmakers, it is probable that the steel foundries could meet higher demands than engineers are now making of them.

British engineers always have striven for the maximum dependability in their products, and they have feared the possibility of having unsoundness and cracks in steel castings. Therefore the latter have been displaced to a large extent, during the last 20 years, by forgings and stampings. However, the author has seen many small steel castings made from small converters, in different automobile factories.

He has seen large converters and electric furnaces used for general engineering steel castings in modern steel foundries, which will stand comparison with any visited abroad, and he has seen large steel castings, such as 30 to 40-ton flywheels for rolling-mill motors, made from open hearth furnaces, so as to machine up without indication of the slightest flaw. The bulk of the steel castings are made of carbon steel, which would comply with one or other of the specifications given in the accompanying tables.

Use Open Hearth

No chemical analysis requirements were placed in the earliest of the relatively few standard specifications for cast steel, which are now in use in Great Britain. The castings must be made from open hearth steel in each of the four grades used for marine purposes (B.E.S.A. No. 30—1907), and one of the grades *B* in this specification is now also used in girder bridge work (B.E.S.A. No. 153—1922). The mechanical properties required of these steel castings are indicated briefly in Table VII.

Steel castings for railway rolling stock only are required to be manufactured by an approved process, which is not specified; but more than 0.07 per cent sulphur or phosphorus must not be shown on their analyses. The mechanical properties for these cast steels for railway rolling stock are simply stated as minima (B.E.S.A. Report No. 24, Part 4—1921; Speci-

Gives Steel Data

WHILE considerable development has taken place in this country in the production of large and intricate cast shapes, in alloy steels, a tendency on the part of British locomotive designers to employ built up steel sections and forgings has delayed progress in the field of alloy cast steels in Great Britain. However, the author states that British foundrymen produce plain carbon steel castings, large and small, that are comparable to those produced in other countries. Manganese steel containing 13 per cent manganese and stainless steels containing 13 per cent chromium, or 18 per cent chromium and 8 per cent nickel are used for certain types of castings. The author also includes physical and chemical data on the steels mentioned in this article which is the second of a series abstracted from a paper presented in behalf of the Institute of British Foundrymen at the meeting of the Association Technique de Fonderie de France.

Table VII

Cast Steel for Marine Work

Grade	U. T. S. pounds sq. in.	Min. Elong. Per cent	Min. angle of bend without fracture Degrees
A.	78,400 to 89,600	15	60
B.	58,200 to 78,400	20	120
C.	58,200 to 78,400	15	90
D.	—not specified—		

Table VIII

Cast Steel for Rolling Stock

Steel used for	Minimum U.T.S. pounds sq. in.	Minimum Elong. Per Cent
Railway castings with wearing surfaces	78,400	10
Railway wheel centers and general castings	58,200	15
Electric tramway wheel center castings	73,900	10

fication 10), and the same applies to cast steel for electric tramway car wheel centers, (B.E.S.A. No. 150—1922) and is shown in Table VIII.

Finally, in the more modern specification for two grades of steel castings for automobiles (B.E.S.A. No. 5028—1924) four chemical elements are controlled, and minimum mechanical properties required, as briefly indicated in Table IX.

Table IX

Cast Steel for Automobile Parts

Grade	Maximum Carbon Per Cent	Minimum Manganese Per Cent	Maximum Sulphur Per Cent	Maximum Phosphorus Per Cent	Minimum U.T.S. pounds/sq. in.	Minimum Elong. Per Cent
1.	0.30	0.40	0.06	0.05	58,200	20
2.	0.30	0.60	0.08	0.07	58,200	15

The most popular alloy steel, so far as castings are concerned, would seem to be that invented by Sir Robert Hadfield. His high manganese steel, for wear resisting purposes, is almost too well known to require mention. It was the first of the austenitic steels to be extensively used, and its abnormal properties puzzled those accustomed to carbon steels. Usually it contains 11 to 13 per cent manganese and about 1.2 per cent carbon, and it is cast into dredger buckets, rail crossings, and many other parts subject to heavy abrasive wear in service.

Castings for ships' propellers, and other articles of relatively small size, up to about 2 tons in weight, have been made in the 13 per cent chromium, 0.35 per cent carbon, martensitic steel called stainless where corrosion resistance was especially desired. Its properties are given in Table X.

Popular as this steel has been in the forged condition, for table knives and many other purposes, it has not proved to be amenable to regular foundry operations, and has been replaced almost entirely by castings of another stainless steel, which is much more resistant to sea water corrosion, and retains its polished appearance untarnished. It contains approximately 18 per cent chromium and 8 per cent nickel.

The author has seen steels of this type, all austenitic in character, with percentages of nickel and chromium, melted in crucibles and cast into many small and intricate articles. Weighing machine parts, shop fittings, taps, valves and sanitary fittings; ship, yacht, tram and railway components, to mention but a few, are being cast in these austenitic nickel-chromium steels. The author has visited locally three different foundries, which have taken up the casting of these new, highly corrosion-resistant steels during the last few years.

Properties of a typical steel of this type are given in Table XI. For heat resisting purposes, several firms now are casting austenitic nickel-chromium steels, to which about 4 per cent tungsten, 2 per cent silicon, and, in some cases, other costly elements, such as molybdenum, vanadium or copper, are added.

Tool steel manufacturers, though most of their products are forged, frequently cast alloy tool steels in sand, molded to the shape of complicated *form* cutters, or other such tools, which would be difficult to produce as forgings.

Book Review

Melting Iron in the Cupola, by J. E. Hurst, author of Metallurgy of Cast Iron, etc.; cloth 240 pages; 6 x 9 inches; published by the Penton Publishing Co., Cleveland and supplied by THE FOUNDRY for $5 plus 15 cents postage. The book may be obtained in England, from the Penton Publishing Co., Caxton House, Westminster, London, S.W.I. for 26 shillings.

This book a large part of which ran serially in THE FOUNDRY from Sept. 1, 1928 to July 1, 1929 inclusive covers practically every phase of cupola construction, operation and maintenance. It is written and illustrated in a manner that will appeal to every foundryman whose work from any angle brings him into contact with the oldest, most convenient and most economical device know for melting iron in the foundry. The author, J. E. Hurst is joint inventor of the Hurst-Ball centrifugal casting process which involves the most expert cupola manipulation. He is a well known British foundry metallurgist, author of *Metallurgy of Cast Iron* and many papers on individual and related phases of the same subject. The scope of the work may be inferred from the eleven chapter headings which include: Historical, construction, operation, charging, receivers, combustion, tuyeres, specials, blowers, linings and briquets. Each one of these subjects is treated in a thoroughly informative manner. Original work on the part of the author has been supplemented by an exhaustive investigation of the work carried on by other practical and scientific foundrymen in this field. Their theories and findings have been incorporated in the text. The book will meet the requirements of the novice who is making his first acquaintance with the foundry cupola. It will serve as a text book for those who desire to teach cupola melting theory and practice to others. To those who already are familiar with the subject, the book will prove an invaluable reference with its wealth of illustrations, tables, formulas and other statistical data. It is printed in large type on heavy paper and is handsomely bound in cloth. In addition to 126 illustrations, and a detailed list of contents, the book carries a cross index listing over 1000 items.

C. W. Miller, has resigned as treasurer of the Jeffery Mfg. Co., Columbus, O., but will continue as a member of the board of directors. H. Supp Jr., formerly credit manager of the company, has been elected to succeed Mr. Miller. J. X. Farrar, formerly assistant purchasing agent, has been appointed credit manager.

Table X

Properties of Chromium Steel

(13 Per Cent Chromium)

Yield Point, pounds/sq. in.	67,200 to 82,900
Tensile Strength, pounds/sq. in.	100,800 to 114,200
Elongation, per cent on 2 inches	20 to 27
Reduction in area, per cent	35 to 50
Bend without breaking	180 degrees

Table XI

Cast M.1 Stainless Steel

(An austenitic Nickel-Chromium Steel)

	Per Cent		
Carbon	0.14-0.16	Y. P. pounds/sq. in.	33,800
Manganese	0.28-0.31	U.T.S. pounds/sq. in.	108,800
Silicon	0.04-0.24	Elongation Per Cent	50
Chromium	17.0-18.0	Brinell Hardness	175
Nickel	8.0 -8.3		

Producing Steel Castings in the Modern Foundry

Part XII

By Charles W. Veach

CERTAIN steel castings require the use of welding or cutting torches in repairing defects or for cutting of runners and risers which are too large to be broken off with hammers. Surface defects sometimes are removed by cutting or welding as the case may be. Welding or cutting operations may be performed either by oxyacetylene or electrical apparatus.

All welds which are large enough to require heating of adjacent sections, cause localized strains, and castings having such welds should be re-annealed. Where welding is done by skilled, competent operators, and the castings are re-annealed, they should be dependable. However, there is much disagreement on where and how much welding may be done on a casting without affecting its utility. Therefore, the consumer and the producer should reach an amicable agreement covering all points on when welding may be performed and the method of carrying it out.

Steel castings of certain designs are prone to cracking while others seldom show such defect. If the design is at fault practically all of the castings first made will crack until remedied. Some may crack wide open while others may show only hair line cracks. This shows that internal strains set up by the shrinking metal are greater in some castings than in others. These strains are the result of resistance offered to the natural contraction of the metal. Strains which appear greater in one section of a casting than another may be due to the design. A certain core also may localize internal strains, and cause the casting to crack in its vicinity.

Strains may be so distributed that no cracks appear, yet be present to a degree that careful annealing is necessary to remove them. In annealing the castings should be heated slowly and uniformly to the desired temperature which will depend upon the carbon content. The castings then should be held at this temperature for a time sufficient to allow all parts of the casting to assume the same temperature. This time generally is given as at least one hour for each inch of thickness of the heaviest casting segment in the charge. The castings then should be cooled slowly in the furnace until they reach a faint red color, after which they may be cooled in the air. To secure a finer structure castings may be heated as mentioned and cooled in still air.

Sometimes a double heat treatment is used to secure a fine structure with great ductility. This consists in heating the castings to a definite temperature based on the carbon content, holding at that temperature until the castings are uniformly heated throughout, and then cooling in still air. After cooling, the castings are reheated to a point just above the lower critical point for a short time, or they may be heated for several hours at a suitable temperature below the critical range. After this reheating the castings should be cooled in the furnace to a faint red color, and then cooled in the air.

In preventing cracks the molder foreman has several alternatives. He may recommend an alteration of the pattern if he believes that the design requires it. This course often is followed. Where the pattern is made in the foundry it is not difficult or expensive to make changes in the design if the consent of the designing engineer can be obtained.

The molder foreman also may observe that certain cores will resist the longitudinal contraction of the metal. He should insist that these cores be bonded with a material which will allow them to crumble as soon as the shrinking metal exerts force against them. These are preventative measures, and should be taken as soon as it is discovered that a casting has a tendency to crack. Other methods often are applied for preventing cracks. Chills are employed by some foundrymen. While they prevent open rupture the strains are present, perhaps in such aggravated form that annealing does not entirely remove them. Another method of pre-

FIG. 24—CLEANING ROOM IN A LARGE STEEL FOUNDRY

venting cracks is to cut thin slots in the mold or cores adjacent to the part where the crack appears in such a way as to form thin brackets or webs at right angles to the position of the crack. The cracking strip as it is called solidifies first and prevents the casting from pulling apart to form a crack. If a large number of chills are used to prevent a casting from cracking, or if cracking strips be cut in a number of places to accomplish the same thing, the casting will have an aggravated form of internal strain. Such a casting will not withstand repeated stresses as well as a casting of like design which has been cast under conditions which make the use of chills or cracking strips unnecessary.

Grinding Is Important

Grinding is one of the important operations in a steel foundry. That department contributes much to the appearance of the castings. It improves the surface by removing excess metal and rough spots that may have made their appearance by chipping and welding or cutting. A thorough study of grinding conditions recently was made at one of the large steel foundries in the country and it was found that by buying the correct grinding wheels for the type of metal being ground, by using modern equipment, and by giving the operators good crane service for large castings and reducing the lost motion by the operators of stand type grinders that grinding costs could be reduced with a consequent reduction of production costs.

Formerly grinding machine operators did not have a long life. The dust corroded their lungs and many times proved fatal. That condition has been eliminated with the modern equipment. Grinding machines now are supplied with an exhaust to remove the sparks and dust, shields to protect operators from the sharp pieces of metal and grit and guards and other safety apparatus. In well supervised plants, grinding machine operators are equipped with goggles and are required to wear them while working.

Grinding machine operators have an important function to perform and can contribute much to the rapidity of flow of castings through the plant by doing good work that is acceptable to the inspectors and that does not require regrinding.

Straightening is the last operation to be performed on the castings before they are spread out on the benches for the customer's inspection. Presses capable of developing high pressure are used for this purpose.

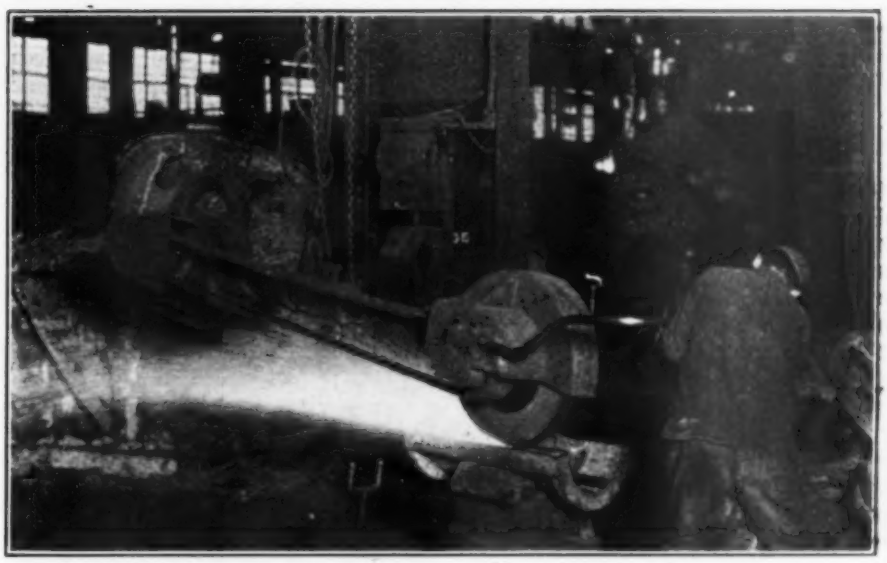


FIG. 25—GRINDING IS ONE OF THE IMPORTANT OPERATIONS

Suitable dies are used to bring pressure where it is needed. Each separate design does not always call for a die. By the use of blocks and wedges, a single die may be made to answer for several designs.

When blocks and wedges are used to bring pressure to bear on a certain part of a casting, considerable hazard is introduced, particularly when the press works fast. To prevent accidents, therefore, it is necessary to caution the operators of the straightening presses to be careful. The operators themselves are not usually in as much danger of being injured as other workmen, because they are aware of the probability of a flying wedge or block.

Straightening is made necessary by warpage which occurs when the castings are shaken out hot, and by that which occurs during the annealing operation. The latter is the cause of most of the warpage. In the annealing operation uneven heating, placing the castings improperly in the oven, and uneven cooling all contribute to distortion of castings of thin section. In continuous work methods of handling soon are established which prevent any undue warpage. However, with the utmost care there may be enough distortion to necessitate straightening.

Where proper provisions are made for handling this work the cost is not great. The operation usually is a piece rate proposition, the largest castings costing but a few cents to straighten. It is an important operation and calls for good judgment. The work is rapid, requires heavy lifting at times, and the edges of

FIG. 26—REMOVING A RISER FROM A STEEL CASTING WITH AN ACETYLENE TORCH

the castings must conform to the straight-edges used for testing them after each straightening operation.

Inspection of steel castings has two objects. These are: To discover, in advance, errors of workmanship or flaws of material that will prevent the production of finished product that is up to the predetermined standard, or made within the limits of the work and to discover imperfect work after its completion and to prevent it being placed in the final product or on the market as first class product.

In a steel foundry inspection to prevent errors and locate flaws is accomplished by stationing inspectors along the line of flow of product at points most convenient for making the inspection without interrupting the movement of the work. The exit side of the sandblast is one of the most convenient points for this work.

Line inspection does not displace final inspection. Every casting should be subjected to careful examination before being removed from one operation and transported to the next. This saves unnecessary handling, and insures against improperly finished work reaching the customer's inspection benches.

Castings Are Inspected

As the castings are placed on the benches provided for the convenience of the customer's inspectors they should be given a thorough examination by the force of final inspectors to discover any flaws or faulty workmanship that may have escaped the notice of the line inspectors. It is a mistake to choose the best men of the inspection force for this work and depend upon less responsible men for the line work. There should be key men among both the line inspectors and the final inspectors.

The chief inspector is an important personage in a steel foundry organization. In authority he is on a horizontal plane with the heads of production departments. The duties of the chief inspector are many and varied. In many steel foundries, he designs all of the gages used by the inspection force. This work calls for mechanical engineering skill of a high order. He also must instruct his men in the use of the gages, and provide a place to store them when not in use. He must check the gages occasionally to see that they are kept in proper working order, and plainly marked for identification.

The ability of the chief inspector to choose and instruct the personnel of his department is of prime importance. As his men are scattered widely, he personally cannot supervise the work of each. He must have men under him who know what is required of them, and who soon learn that they contribute no small part in the attainment of high standards of work by the finishing department. A skilled chipper makes a good inspector to place over inspection at the chipping benches, and a man skilled both in chipping and welding makes a good man to place over the final inspectors.

The chief inspector should acquaint himself with each operation in the steel foundry, and particularly he cannot acquire too much knowledge of the metallurgical processes. He should keep himself informed in

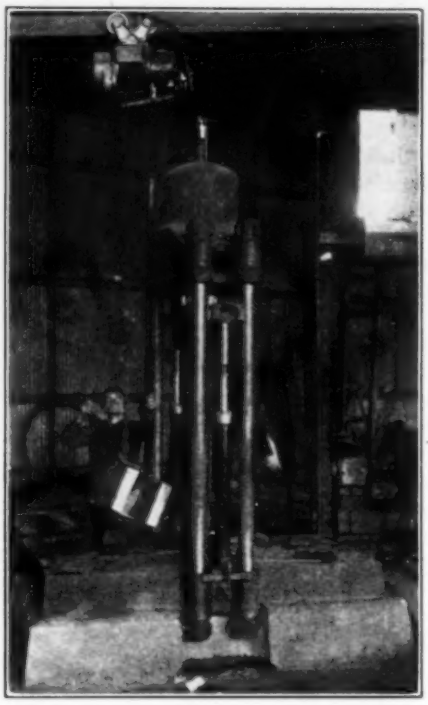


FIG. 27—HYDRAULIC STRAIGHTENING MACHINE MAY BE USED

regard to all the latest developments in heat treatment, and be in close touch with these operations in his own foundry.

Knowledge of the place a casting occupies in the assembled unit is indispensable to the inspector. Tolerances for length, breadth, height, and thickness of section usually are clearly stated in the specifications furnished by the customer, yet too zealously endeavoring to stay within definite limits involves expense which might be avoided if the chief inspector understands the assembly. When connecting parts of the assembly have thin sections, spreading or drawing may not be objectionable but when these parts are of thick section and stiff, close fits are necessary to avoid difficulty in the assembly work.

A broad minded chief inspector familiar with steel foundry problems, and possessing in large degree that all important quality *tact*, contributes as much as any other foundry executive to the attainment of high standards of workmanship and high quality of product. Instead of criticising faults in workmanship or flaws in the material he will point out where improvement is desired without offering suggestions as to how the work should be done. As soon as he begins to find fault antagonism begins between the other executives and himself, and the spirit of co-operation is weakened.

Discusses Castings Weight

The placing of the responsibility for the weight of castings is a question. It is evident that the manager of production is interested vitality, for a large number of castings are sold not at so much a pound, but at so much per piece or per set. Under this condition of sales, overweight cuts profits. While underweight increases profits, if the average weight falls below that called for by the dimensions of the pattern, it clearly is the duty of the inspection department to discover the cause of the discrepancy in weight and to see that corrections are made. If the pattern is at fault the condition will be discovered before the work has been established on a production basis, and adjustment made before castings are shipped.

Foundries on continuous or production work are greatly handicapped if a customer's inspector delays movement of castings from the inspection benches. If he is slow the flow of castings will be slower further back or castings must be piled wherever room can be found and added expense is incurred. The chief inspector should know what will be acceptable to the customers' inspectors with whom he has dealings and he should permit no work to pass to the inspection benches until it is in proper condition.

Grinding Wheel Company Increases Capacity

Sterling Grinding Wheel Co., Tiffin, O., is constructing a dormer type building 122 x 145 feet which will give the company about 18,000 additional square feet of floor space for manufacturing. When that unit has been completed another similar building will be erected. New equipment is being purchased for the new units and is being installed. The company expects to have the major part of the program completed early in 1930. George S. Rider Co., Cleveland, is the construction engineer.

Fig. 1—An Open Sand Mold Is Made Up Around the Intersection and Filled with Iron

Diversity of Product CONTRIBUTES TO SUCCESS

By Herbert R. Simonds

SEVENTY odd years ago a small foundry was started in Cambridge, Mass., to make a general line of jobbing castings for several machinery manufacturers in the vicinity. This foundry, in continuous operation ever since and known for many years as the Barbour-Stockwell Co., is now one of the largest jobbing foundries in New England.

During the past 25 years its destinies have been guided by Fred Stockwell who is perhaps best known as the perennial secretary of the New England Foundrymen's association. He disclaims any particular credit for the success of the foundry, but he admits that the manufacture and sale of several complete articles has afforded invaluable assistance in weathering many periods of foundry depression. He thinks any jobbing foundry would do well to manufacture a few items of equipment or complete machines for direct sale. Such products make it possible for a foundry to keep molders busy when the regular jobbing demand drops off. If the demand for the complete product also declines the management may have sufficient confidence in its ultimate recovery to warrant continuing manufacturing and placing the output into stock.

In Mr. Stockwell's opinion a well diversified output is the best insurance against declining orders. Soon after taking charge of the foundry he became interested in the manufacture of bakery machinery. After his designing department had worked out some improvements he started this as a regular part of the plant's operations, and the company is still successfully producing and selling bakery machinery. Incidentally, one of the first dough mixers was erected in the foundry to mix facing sand; and it is still on the job.

Another and entirely different field of interest is frog and switch production. The growth in street railway construction the latter part of the nineteenth century started the company in this specialized line. New methods and designs have been developed and the work has expanded to form a separate department with an

Fig. 2—When Completed, the Frogs Are Virtually of One Piece Construction

output in a recent year valued at approximately $1,000,000.

Since the development of the frog and switch business many other departments have been added. Other companies were absorbed, including the Broadway Iron Foundry, founded in Cambridge in 1864, to handle iron and brass castings. This firm prospered for many years and gradually built up a reputation for excellent workmanship. In 1928 it was merged with and moved in its entirety to the plant of Barbour-Stockwell Co., a few blocks away. In 1923 the Blanchard Instrument Co. was purchased by Barbour-Stockwell Co. and taken into the organization as a separate department. For many years the castings for the Beaudry Champion Power Hammer Co., established in 1885, were made at the Barbour-Stockwell foundry. This company was taken over by the Barbour-Stockwell Co. in February, 1929, and now is operated as a department. In 1923 the United Hammer Co. was purchased. With two lines of power hammers, the company definitely has entered the machine tool field.

The present organization is divided into eight distinct departments: Engineering and research; pattern shop; foundry; machine department; power hammer department; instrument department; street railway department; forging and heat treating department. The engineering and research department has been expanded recently under the direction of Mr. Stockwell's son, Ernest. The aim of this department is to help in the design and production of machines for customers. The department has complete facilities for translating ideas which materialize into practical working blueprints.

Fig. 4—A Wide Variety of Miscellaneous Castings Is Made in the Old Section of the Plant Which Still Is Equipped with Jib Cranes

Fig. 3—The Rollover Machine Is Served by a Roller Conveyor

More than 60 molders now are employed regularly in the production of gray iron, semisteel, brass, bronze and aluminum castings. Fig. 7 shows part of the pattern department where patterns in wood and various metals are made for hand and machine molding either for special orders or on a production basis. Patterns also are made for other foundries. The pattern in the foreground illustrates one line of work which finds a fairly steady outlet as an architectural feature in New England building construction. This is an ornamental grill for the railing of a new hotel. As a large number of these grill pieces were required, it was possible to organize for production work, as shown in Fig. 3. Here a roller conveyor has been brought up to the automatic jolt rollover molding machine and the completed molds are pushed along it, one after the other, in position for pouring. The machine has a capacity to handle loads up to 2000 pounds.

Many castings are made in the Barbour-Stockwell foundry for the grill work used in hotel entrances. In many cases the castings are bronze, but iron frequently is used in similar ornamental work. This particular class of work, although somewhat specialized, offers a promising field for a general jobbing foundry. In New England at least, the use of ornamental castings in building design is again on the increase after a period of depression. Here, then, is seen the theory of diversity working out. A slack period experienced in street railway work is offset by an increase in the use of castings by the building trades.

Part of the flexibility of the Barbour-Stockwell plant comes through its use of many different metals. Aluminum lasts are made for the shoe industry and heavy semisteel castings for power hammers. Between these two, light and heavy castings in bronze, brass and gray iron supply the needs of machinery builders in a hundred different fields.

Fig. 6—The Brass Foundry Is a Recent Addition to the Barbour-Stockwell Plant

Fig. 5—Jobs Which Lend Themselves To Repetition Methods Are Made in the New Section of the Foundry Equipped with Molding Machines and Other Appliances

One corner of the brass foundry is shown in Fig. 6. The pit crucible furnaces are located in the far corner and at the right is shown a unique hand lever device suspended from an overhead hoist and used for the rapid raising of heavy crucibles out of the furnace pits. A simple support made of light channel with pipe section legs welded on at intervals, serves to keep the completed molds off the floor and at a more convenient height. The brass foundry, as may be seen, is well lighted and well ventilated. Other parts of the plant are not all so well favored in this respect, and the equipment ranges from the most modern to old wooden jib cranes, which must have been built more than 50 years ago. These may be seen on part of the heavy floor molding section, shown in Fig. 4. Adjacent to this room is the modern gray iron molding and pouring department shown in Fig. 5. The old and the new are found side by side. The plant gradually is being altered to bring it all in line with the most modern practice. In the meantime some old methods are successfully competing with the new. Perhaps diversity of method as well as of product is an advantage. The molding of railroad frogs embodies old and new principles. A typical frog in process of construction is shown in Fig. 1. Four sections of standard flange rail are machined to fit and are set in cross or "x" position with a space of from 2 to 3 feet left at the actual point of

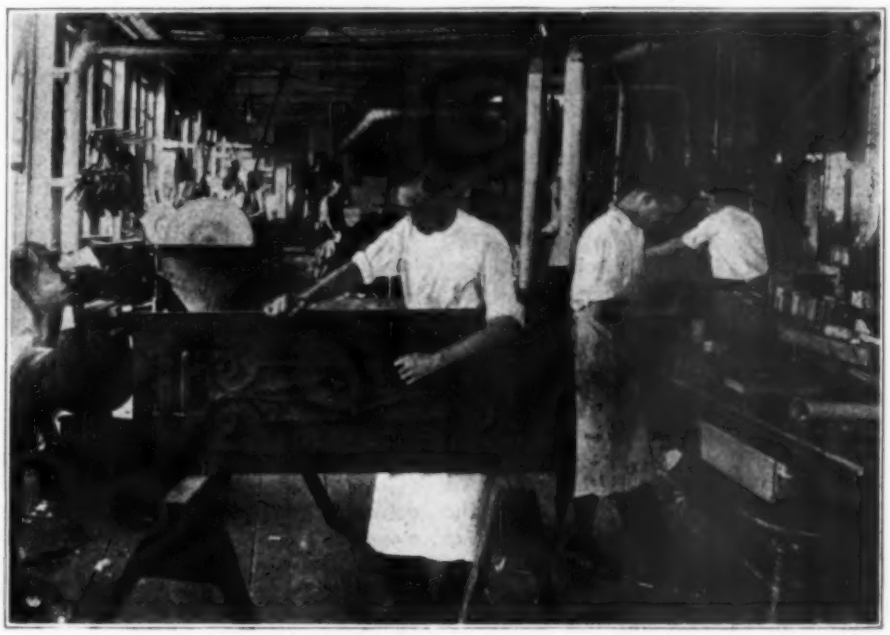


Fig. 7—Pattern and Gates for Railing Section Mounted on a Plate

intersection. An open sand mold made up principally of dry sand cores is assembled on both sides of the junction. Molten iron is poured into this mold until the intersecting rails are gripped in a solid block of iron, virtually of one piece construction. Three of the completed frogs are shown in Fig. 2.

Manufacture of tachometers is a class of work not usually associated with a foundry. However, this department has proved to be a profitable one, and insures an attractive demand for small brass castings on a production basis. It also serves to keep the engineering department busy during the otherwise quiet periods. New types of tachometers and improved construction details are products of that department.

Explains Oven Design

Swartwout Co., 18511 Euclid avenue, Cleveland, recently has published a catalog on industrial ovens. Descriptions of some of the factors of design, both of the ovens and doors, and features the special method of insulation used in the equipment that the company manufactures are included. Oven ventilation, core room ventilation, and oven heating also are discussed. The next section of the bulletin contains descriptions and illustrations of the various types of ovens that the company makes. A further discussion of oven heating, ventilating, and temperature equipment and various types of doors is included in the final section of the bulletin. It also contains a partial list of users of the equipment. Many illustrations of typical installations and line drawings are shown throughout the catalog.

Internal Chill Is Unusual

By James T. MacKenzie

While internal chills sometimes do occur, the accompanying photograph shows one of the most unusual cases of this nature that the writer ever has seen. As may be observed, the edges, corners and center of the bar are perfectly gray, but two fields of almost white iron occupy the area between the middle and edges. Three bars, rectangular in section 1 x 2 inches, were cast in dry sand in this set. The photograph is approximately full size. The internal chill exhibited was more pronounced than in the other bars although traces of this peculiarity were visible in the other two. The decided chill shown was visible in but one bar and that only in approximately the middle half of the length of the bar. Another set of bars poured from the same heat of approximately the same analysis did not show this internal chill.

The analysis of the bars is as follows: Total carbon, 2.7 per cent; silicon, 2.4 per cent; sulphur, 0.24 per cent; manganese, 0.5 per cent, and phosphorus, 0.2 per cent. The iron was melted in a 28-inch shell cupola using a by-product coke with rather poor structure containing 14 per cent ash and 1 per cent sulphur. The bars were taken from the third remelt of an all-steel heat. The second remelt which formed the raw material of the melt in question was

EDGES AND CENTER ARE GRAY WHILE AREA BETWEEN IS WHITE

quite normal as was the fourth remelt which followed it.

No reasonable explanation for this freak performance occurs to the writer at this time. It is shown simply as a matter of general interest.

Book Review

Spark of Steel, by E. Pitois, translation from French by John D. Gat. cloth, 89 pages, 6 x 9 inches, published by the Chemical Publishing Co, Easton, Pa., and supplied by THE FOUNDRY, Cleveland, for $2.00 plus 15 cents postage and in London by the Penton Publishing Co., Ltd., 415-17 Caxton House, Westminster for 10s, postage extra.

In this work the author, who is chief inspector of the construction section of the governmental air service, France, has shown by means of illustrations that steels of different analyses give various kinds of sparks when ground. The book gives the advantages and describes the technique necessary for the determination of steels by this method. The book contains 32 photographs of the spark streams of different steels which will aid in their identification by grinding. As a further investigation in that line, the author has allowed the sparks to impinge themselves on pieces of glass covered with a film of gelatine and has studied the incrustations. The results are given in the book. The final chapter in the book was written by John A. Houtz, Central Alloy Steel Corp., Canton, O. It is devoted to a description of how this test is conducted in the United States and tells some of its commercial applications in the grading of scrap.

Makes Permanent Molds

(*Concluded from Page* 955)

and well fluxed. Among several good preparations on the market, zinc chloride may be mentioned as satisfactory for the purpose. Frequent stirring of the metal will insure a uniform alloy in the castings. Pouring ladles, stirring rods etc., should be freshly coated with iron oxide or zirconium clay each night. Old coating should be removed from the molds each day by a wire brush and a fresh coating applied to protect the molds and insure smooth castings. The fresh coating only can be applied satisfactorily after the mold is cool. With reasonable care, the life of permanent molds for aluminum work is indefinite. Production of from 100,000 to 150,000 castings from a single mold is not unusual. Movable cores, sprues etc., require more frequent renewal.

The number of castings which a permanent mold is capable of producing per hour varies with the type and size of the casting and to no small extent on the efficiency of the mold designer. A well designed mold should produce from 25 to 60 good castings per hour. Even in the case of larger and more complicated castings, it is a poorly designed mold which is not capable of producing 25 good castings per hour.

Talks to Foundrymen

W. Wardley Kerlin, Conneaut, O., research chemist of the Enterprise Sand Co., Pittsburgh, spoke before the Pittsburgh Foundrymen's association at its first meeting of the season held at the Fort Pitt hotel, Oct. 21. The meeting was attended by 85 members.

Mr. Kerlin gave an illustrated talk on "Grain Size and Its Effect on the Properties of Molding Sand," discussing the mixture of various types of sand and their proper use for different types of casting work. The speaker has been identified with a number of large industrial concerns in metallurgical work and for the past three years has been devoting his full time to core and molding sand problems.

The November meeting of the Quad-City Foundrymen's association will be held at the Le Claire Hotel, Moline, Ill., Nov, 18. Walter L. Ranis, metallurgist, Union Malleable Iron Co., East Moline, Ill., will speak on sand control.

Questions & Answers on FOUNDRY PRACTICE

GRAY IRON

Makes Grinding Balls

QUESTION

For some years we have been making white iron balls and liners for mills used in grinding ores and have used straight white pig iron for the purpose. These liners and balls are used to replace manganese steel and chrome steel balls and liners. What in your estimation is the best composition or analysis of iron for this work? Can you give us any idea on how the durability of the mentioned steels and white irons will compare?

ANSWER

Two analyses suggested for white iron for balls and liners are: Silicon, 0.8 to 1.00 per cent; sulphur, 0.08 to 0.10 per cent; phosphorus, 0.2 to 0.4 per cent; manganese 0.8 to 1.2 per cent; combined carbon, high and low total carbon; the second is an alloy white iron containing chromium: Silicon, 0.7 to 0.9 per cent; manganese 0.7 to 0.9 per cent; chromium, 0.6 to 0.8 per cent. Chromium in the iron makes it tough and abrasion resistant. To lower the carbon content, steel scrap up to 30 per cent may be used. Iron molds should be used in making the balls and the iron should be melted and poured as hot as can be obtained otherwise cold shuts, gas holes, etc., may appear in the finished casting.

No information is at hand on the durability of manganese steel as compared with white iron, but we should imagine that the steel owing to its extreme resistance to abrasion and wearing would last considerably longer. Manganese steel liners sometimes weld together due to the peining action of the ore and balls, so much so that in case of repair the acetylene torch has to be used to cut them apart which occasions a great deal of delay. The only way that a reliable comparison could be made, is to determine the amount of balls and liners used up per ton of ore ground. In this way the price difference between white iron and manganese steel could be shown with the costs.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Cast Steel
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

Q & A

Increases Chill in Iron

QUESTION

We are having a difficulty in getting a good chill on a small truck wheel 16 inches in diameter with a 4-inch face which weighs 180 pounds. We have a chill that is 3 inches thick and weighs 200 pounds, and have been using a mixture containing 400 pounds of pig iron and 600 pounds of scrap. The chill we obtain is only 1/16-inch deep, and is not satisfactory.

ANSWER

You do not state what your present analysis is nor how deep a chill will meet the requirements. However, it is apparent that your difficulty is due to the silicon in your mixture being too high. If the silicon is above 1.5 per cent, it will be practically impossible to obtain a chill deeper than you now are getting. Therefore, it will be necessary to change your mixture. You may be able to obtain the desired chill by substituting enough chilled car wheel scrap, by using lower silicon pig iron, by adding steel scrap, or by a combination of the three. A suggested mixture is 150 pounds steel scrap; 250 pounds chilled car wheel scrap; 200 pounds return foundry scrap, and 400 pounds pig iron containing not over 1.6 per cent silicon. This will give about 1 per cent silicon in the resulting casting which should have a moderate chill. If a deeper chill is desired, reduce the return scrap and increase the car wheel scrap or the pig iron.

Q & A

Rolls Are Too Soft

QUESTION

We are making some small rolls used in power operated sugar mills but they do not wear well. We are using charcoal iron containing 1.70 to 1.76 per cent silicon, 1.46 to 2.37 per cent manganese, and 0.10 per cent phosphorus with 5 to 7 per cent steel scrap. Also we are having difficulty in making hard, tough plow points that will wear well. Can you give us a composition for these? In addition to the charcoal iron mentioned we can obtain one containing 1.26 to 1.38 per cent silicon, 1.24 to 2.13 per cent manganese and 0.10 per cent phosphorus, and another containing 2.06 to 2.26 per cent silicon, 2.21 to 2.89 per cent manganese and 0.10 per cent phosphorus.

ANSWER

Many of the rollers used for sugar cane made in this country have a much higher phosphorus content than you will be able to obtain. This runs around 0.50 per cent and some instances much higher. It is said to give a hard network that does not wear as fast as the body of the casting, and hence will grip the cane better than a smoother roller. Since you have difficulty in making rolls that will wear well we suggest that you add more steel scrap to your mixture. This should run around 15 to 20 per cent. If this does not make the rolls hard enough, change over to the No. 2 grade pig iron to reduce the silicon. You will have to experiment to obtain the best balance between the

steel and iron. Also when using steel additions it would be a wise plan to use a mixing ladle at the spout. This ladle should be large enough to hold two or three iron charges as charged into the cupola.

Also we suggest that you use the iron containing the higher percentage of manganese. This will lessen the effect of the sulphur resulting from the use of steel scrap. When large amounts of steel are used the coke between charges and the amount on the bed should be increased. Use enough to obtain good, hot iron at the spout.

We assume that the plow points you refer to are made in chills. If this practice is not employed, we advise that chills be used because this method will give a hard white point, backed up by a mottled or gray interiod. This method is employed in this country. The analysis generally used is as follows: Silicon, 0.75-1.25 per cent; sulphur, low as possible; phosphorus, 0.20-0.30 per cent, and manganese, 0.80-1.0 per cent. Considerable steel and hard scrap such as car wheels are used in the mixture. The scrap used runs from 50 to 90 per cent, and in some cases from an all scrap mixture. Steel additions run from 20 to 25 per cent. If you have not had much experience in handling large additions of steel scrap, we suggest that you begin with a lesser amount than that mentioned, and work up to the higher quantity.

Q & A

Keep Tap Hole Clean

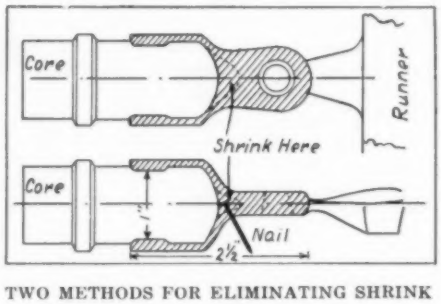
QUESTION

For some time we have been melting a miscellaneous mixture of steel, cast iron and wrought iron scrap to pour into sash weights. The iron freezes around the tap hole and we cannot get a bolt to take hold. We have to clear away a mess, shut off the blower and as a result the following iron is so cold it will not run the castings. We shall appreciate any information that will show us a way out of this trouble.

ANSWER

Boiled down to a single sentence all your trouble is due to the fact that you are not melting the iron hot enough. You do not give the size of the cupola or the weights of the coke and iron charges, therefore we cannot say whether the iron charges are too large for the size of the cupola, or the coke charges are too light for the amount of iron. From the fact that a few minute's shut down renders the iron too cold to run castings like sash weights, we are inclined to the opinion that the bed in the cupola also is too low. The obvious remedy is to increase the coke both in the bed and between the charges of iron, until the iron runs from the spout as clean and liquid as water. Iron melted at a proper temperature will not leave any frozen crust either on the sides of the spout or around the tap hole.

However, in your particular case, the low carbon, low silicon character of the material you are melting yields a metal at the spout that freezes much more quickly than ordinary gray foundry iron. Sometimes, even with the best of care the cupola man will cause a slight splash in stopping the stream. This splash solidifies in a crust and forms a foundation on which succeeding splashes freeze more easily. The clay or other material used in botting the tap hole will not stick readily to iron. To prevent this condition, the first remedy outlined is the best. That is melt the iron so hot that it will not stick. Where the iron shows a tendency to freeze,



TWO METHODS FOR ELIMINATING SHRINK

it should be cleaned away completely at each tap and thus keep the tap hole clean for the reception of the bott. With a furnace that is handled properly the tap hole will be the same size and shape at the close of a heat as it was at the beginning. It should not be allowed to grow with successive accumulations of clay and iron.

MALLEABLE

Casting Shrinks at Neck

QUESTION

We are having considerable trouble on account of a shrink spot in the neck of a small malleable casting shown in the accompanying sketch. Formerly we gated the casting close to this neck and had comparatively little trouble with the casting breaking on account of the shrinkage. However, with a view of getting a greater number of castings in a flask we changed the gate to the position shown in the sketch and have had constant trouble since. We shall be glad to consider any remedy you may suggest for improving our practice.

ANSWER

The most obvious remedy that comes to mind is to change the gating system back to the style in vogue when the castings were satisfactory. However, if for any one of many reasons that is not practical several methods are available. The shrinkage takes place at a point in the casting where the metal is thicker than it is at any other point. Evidently then the problem is to equalize the thickness, or, introduce some element in the mold that will cause the metal in the thick portion to set as rapidly as the metal in other parts of the casting. The first suggested remedy is to extend the end of the core as shown in the dotted line. This will remove the heavy body of metal and cause the casting to set more uniformly. The second remedy is to leave the core as it is, but insert a nail in the drag side of each mold with the head projecting into the mold cavity at the neck. The nail will cause the metal in the heavy section to congeal more rapidly than otherwise would be the case. The third remedy is to cast the neck in a chill. It may be that the gate is sucking metal from the castings instead of feeding them. Try a higher head and cut the gates entirely in the cope.

GENERAL

Sand for Auto Pistons

QUESTION

We are experiencing considerable trouble with the core and molding sand in which we are making replacement pistons for automobile engines. Can you tell us what kind of sand is employed by the various automobile foundries? Have any standard mixtures been developed for the purpose and if so where can we secure information on the subject?

ANSWER

Many times in recent years we have carried descriptive articles on automobile foundries and in practically every instance reference was made to the sand used for making the molds and the cores. Natural sands suitable for the purpose are available within a reasonal distance of all the principal automobile centers and they have not found it necessary to prepare any elaborate mixtures. The cores are made from a fine grade of clean sharp sand bonded with oil in the majority of cases, although other binders also have been employed satisfactorily in many cases. The molds are made from sand with high a silica content and with a grain formation that renders them permeable. This sand may be rammed quite hard, which is an important factor in preventing over weight castings from strained molds. It does not scab or buckle or *burn on*

to the face of the piston casting.

You do not state in just what particulars the core and molding sand has proved unsatisfactorily, but we assume you refer to the usual troubles encountered by many jobbing foundrymen when they attempt to duplicate the product of a highly specialized industry. Your molding sand at present probably is low in silica content and high in clay and as a result the castings are rough when the sand is rammed hard and strained when it is rammed soft. The obvious remedy is to secure a sand with the necessary qualities and failing that to add a sufficient amount of fine, clean sharp sand to form a synthetic sand with the necessary properties. A great deal of valuable data on sand has been collected by a committee of the American Foundrymen's association and we suggest you communicate with R. E. Kennedy, technical secretary of the association 222 West Adams street, Chicago.

Q & A

Trouble Due To Wet Sand

QUESTION

We are sending two small castings for your examination and will appreciate your opinion on the probable cause of the defects which show on the surface. In one of these you will note a cavity where the gate was attached, in the other the defective area did not appear until after the casting was partly machined. The trouble appears to come and go intermittently. We may have no trouble for months and then these defective castings appear for a day or two. Afterward for no apparent reason the trouble seems to adjust itself and we hear no more of it for some time. Our cupola practice conforms to regulation standards, the iron is hot and fluid and of the following approximate analysis: Silicon 2.50 per cent, sulphur 0.09 per cent, phosphorus 0.42 per cent, manganese 0.55 per cent, graphitic carbon 3.25 per cent, combined carbon 0.30 per cent. We have varied the silicon and manganese content at times in an effort to discover the cause of the trouble, but apparently the analysis is not responsible.

ANSWER

From an examination of the castings submitted we are of the opinion that the condition of the sand in the mold is responsible. It has been either too wet or too hard or possibly a combination of both. This supposition is strengthened by the statement that the trouble only appears intermittently. Apparently your sand is of a suitable grade and prepared in a proper manner practically at all times. However, occasionally a slip of some kind occurs which is reflected in your castings. Naturally you are familiar with the fact that steam is generated when molten iron comes into contact with green sand. If the steam has an opportunity to escape freely in a direction away from the iron, it will do so and the resulting casting will be perfect. If for one of several reasons, the steam has to force its way through the iron it will leave the mark of its passage either in the shape of a definite opening or in a honeycomb structure in which the cells may be filled with a mass of material resembling slag.

Q & A

Desires Hard Metal

QUESTION

I want a little hard iron from time to time, never in excess of 150 to 200 pounds. In fact if it were white it would suit me better. How would you suggest getting it. Can I add anything to the ladle and in what proportion? The iron from the cupola generally is quite hot and should care for any additions I might make.

ANSWER

If you have a small cupola, the best way to obtain hard or white iron would be to charge a large amount of steel at the end of the heat. This would melt quickly in the hot cupola, and since it is put in at the end of the heat, it would not interfere with your other castings. To give evidence that the other iron has been melted and out of the cupola, an extra heavy split of coke between the last regular charge and the steel mixture would practically stop melting at this point until the coke was burned sufficiently and then melting would proceed.

You might try adding scrap steel to the ladle, but unless the ladle is extremely hot and free from over iron, and the iron poured on the scrap is extremely hot, poor results will be obtained. Steel or other scrap cools molten iron rapidly. You might lower the cooling effect by having the scrap previously heated to a red heat being careful not to allow scale to form during the heating. We cannot say how much to add as we do not know the analysis of your present iron, and as previously mentioned the effect of cooling determines how much steel will be absorbed before it becomes too cold to pour.

Another method that might be tried is the addition of ferrochromium to a ladle of iron. The ladle must be red hot and free from over iron. The ferrochromium must be of small size, preferably about 20 mesh, and the iron extremely hot. The method of addition is to place the ferrochrome in a paper sack. Then cover the bottom of the ladle with iron from the cupola, and throw in the bag at the junction of the molten metal stream and the metal in the ladle. To make sure that the chromium is all melted, stir the ladle with an iron rod a few times and then pour the castings. Needless to say the utmost precaution should be observed in the process of adding the powdered ferrochrome and in introducing the rod. Both should be heated before being used.

The amount of ferrochrome that may be added this way is about 0.50 per cent or about ¾-pound of 65 per cent ferrochromium per 100 pounds of iron. This amount of chromium should give a hard iron which may be mottled in structure, but probably not white, if the silicon is low.

STEEL

Molding Alloy Steels

QUESTION

What molding practice is observed in making castings of stainless iron and steel and nickel-chromium alloys. Does it follow that employed in making steel castings? What kind of facing is used? Are the castings tender in the sand? What precautions should be observed?

ANSWER

The molding practice for the stainless metals and the nickel chromium alloys in general is similar to that used in the manufacture of steel castings, and the facing sands used are for the most part those that are found in steel foundries. The range of analyses of these steels is so wide that it is difficult to give general instructions that will apply to all the metals of this class. In general, the alloys lower in carbon are rather sluggish and require somewhat larger gates than the higher carbon metals, to insure filling the molds without misruns. The lower carbon compositions are not particularly tender in the sand, but the high carbon stainless steels require careful handling in this respect. All metals containing large amounts of chromium are prone to scum over readily, so that it is difficult to judge their temperature in the ladle, and to handle the metal rapidly enough to secure clean castings and sharp corners properly filled out in the molds. Without careful and rapid handling considerable loss may be experienced from misruns of light castings due to the sluggishness of high chrome metals and their tendency to cold shut unless the molds are so arranged and vented that the metal can fill them with the minimum of delay. The metal is generally found extremely hot necessitating highly refractory sands.

Problems in Nonferrous Founding

By Charles Vickers

Castings Are Rough

We have to make a number of brass bushings 4 and 5 inches in diameter by 12 inches long, in which we put cores ¾-inch diameter. We are unable to make a core that will stand up. We also experience trouble in the mold itself as when we shake out the castings we find them rough on the outside with a coating of part brass and sand difficult to remove. In other words the brass has cut into the sand walls. Can you advise us how to remedy these difficulties? We use a molding sand similar to the Albany brass sand, and the metal is 85-5-5-5 in ingot form.

The main difficulty probably came from using a molding sand that is too fine and close for the job. The cores are a separate and familiar problem; a slender rod of sand is surrounded by from 2 to 2½ inches of molten bronze, probably poured quite hot to avoid shrinkage. We visualize these molds as being made on end, that is the bushings are stood on their ends in molding, which of course is a good way to mold them. Get a supply of molding sand of the grade of No. 2 Albany and make the entire mold of it, using it on the dry side always for vertical ramming. If no heavier sand is available, make a facing of new molding sand, 10 parts; sharp sand, 5 parts and fine fireclay, 1 part. Mix these dry, then dampen with molasses water to the consistency of molding sand.

This is for green sand molding, and use a blanket at least 2 inches thick around the patterns. Where the backing of fine heap sand adjoins the facing, drive down a heavy vent wire to make a ring of perpendicular holes, and connect them with the flask joint. This facing sand will require coating with plumbago brushed dry on the mold for green sand. It is a lot more trouble to use this facing but it will give good results in the absence of the proper sort of molding sand. It does not hurt the molding sand to get a brushing of plumbago. It is advisable also to part the mold at the bottom also as it is just about as easy when molding upright. To make the cores use dry lake sand and dry new molding sand and mix them in the proportion of 7 parts Lake sand to 5 parts new molding sand. Bond them with linseed oil in the proportion of 32 parts of the mixed sands to one part of the oil. If a core machine is used which is best, use the proportions of oil and sand given by the manufacturer, as it may happen that it will be necessary to incorporate some flour. The cores should have a good vent for this work, give them a preliminary coating of plumbago swabbed on. Then when dried rub on plumbago mixed with molasses water, or with kerosene to a paste. Rub it on the cores and polish them.

Q & A

Remelts Aluminum Chips

We have on hand several tons of aluminum shavings which we are obliged to sell for 9 cents per pound as we have no way of utilizing them ourselves. The metal is high grade nickel-aluminum alloy and is derived from machining operations on aluminum pistons. Can you suggest a way in which we could remelt the material into ingots and thus obtain a good price for it, and if so, what sort of a home-made melting furnace would be suitable?

This material can be put into ingot form by melting and pouring into suitable ingot molds. However, we do not like the idea of the home-made furnace as the tool for doing this as we believe that advertisers in THE FOUNDRY who specialize in furnaces for melting such alloys could provide a properly designed furnace for this work that would be incomparatively better, and much cheaper in the end, than any home-made one possibly could be. We suggest that you write such advertisers for particulars. An iron pot melting furnace is the best for use for this work. It should be oil-fired, or gas-fired and have a capacity of several hundred pounds. To melt such light material as these shavings it would be necessary first to obtain some solid chunks of aluminum such as ingots, and melt them to get a bath of metal. When the bath has been brought to a dull red, dissolve turnings until it becomes too cool. Then the bath is reheated and more turnings added, and so on continuously until the pot is filled, when metal should be dipped out and ingoted until the pot is half empty. Then dissolving process should begin again. In the evening the pot should be emptied entirely, to be started up next morning with ingot again. In this way the work would proceed quietly and there would be no danger of burning the aluminum or ruining the pot. This work, of course would add to the price of the aluminum, so that the saving effected might not be so great as anticipated.

Q & A

Copper Is Too Low

We are making some automobile manifolds of an unusual type, and while the castings have come out beautiful in appearance and machine without showing any defects, we have trouble with them standing a pressure test. This consists in submerging the castings under water, then applying air at 40 pounds pressure when slight leaks are visible in most cases, and more aggravating in a few cases. Can you make any suggestions that may enable us to solve this problem? We use aluminum alloy No. 33, S.A.E.

Alloy No. 33 S.A.E. is not sufficiently dense in structure for castings to withstand pressures. Increase the copper to a minimum of 10.5 per cent for manifolds. If leaks still develop increase the copper still further to a maximum of 13.5 per cent copper.

Q & A

Withstands Pressure

Can you please advise us of a formula for an aluminum-zinc alloy that will stand 1000 pounds per square inch, or near that pressure for grease gun castings?

Try the following alloys, 84 per cent aluminum; 13.25 per cent zinc and 2.75 per cent copper; and 77 per cent aluminum; 20 per cent zinc and 3 per cent copper.

Steel Founders
Plan New Association Activities

Report of Recent Survey of Steel Industry Is Made at Chicago Meeting —By-Laws Are Adopted and New Officers Elected

WITH a registered attendance of 108 men, representing outstanding organizations in the industry, the Steel Founders' Society of American laid the ground work for broadened activities at a meeting held in Chicago, Oct. 29. President J. E. McCauley, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., in his opening address, stressed the care and preparation which attended a survey of the industry since its last previous meeting, held at White Sulphur Springs, W. Va., June 27-28, 1929.

Granville P. Rogers, who was selected as managing director just prior to the previous meeting, presented a complete and comprehensive report, covering the results of the survey, his recommendations as to the future course of the society, a set of by laws involving a reorganization, various data relating to membership, and association activities to be furthered. The reading of this report occupied the entire morning and a portion of the afternoon meeting, a luncheon being provided to break the continuity of this long session. High lights of this report will be presented later.

At the luncheon meeting, a communication from C. F. Abbott, director, American Institute of Steel Construction, offered words of encouragement and advice to the industry, urging it to join in co-operative effort along merchandising lines under the guidance of Mr. Rogers. Roger L. Wensley, president G. M. Bassford Co., industrial advertising councillors, New York, in delivering the principal address at the luncheon, pointed the way to effective advertising as an aid to better business.

On completion of Mr. Rogers' report at the afternoon session, his recommendations were adopted unanimously, as were also the by-laws which for purposes of representation on the board of directors, divided the country geographically into five divisions. Officers unanimously were elected in accordance with the new by-laws. The nominating committee included B. C. Wait, Milwaukee Steel Foundry Co., Milwaukee, A. H. Jameson, Malleable Iron Fittings Co., Branford, Conn., and F. E. Hinners, Geo. H. Smith Steel Castings Co., Milwaukee. The officers elected from the slate selected by this committee were as follows:

President, J. E. McCauley, Birdsboro Foundry & Machine Co., Birdsboro, Pa; vice president Eastern division, W. H. Worrilow, Lebanon Steel Foundry, Lebanon, Pa.; vice president Central Atlantic division, J. E. Galvin, Ohio Steel Foundry Co., Lima, O.; vice president Midwest-Southern division, Arthur Simonson, Falk Corp., Milwaukee, Wis.; vice president Mid-Continent division, E. H. Cornelius, Oklahoma Steel Casting Co., Tulsa, Okla.; directors Eastern division, three-year term, R. J. Doty, Reading Steel Casting Co.,

Heads Steel Founders Society of America

JOHN E. McCAULEY, re-elected president of the Steel Founders' Society of America, has been identified with the foundry industry for more than 25 years. He was born in Mifflintown, Pa., July 18, 1882. He completed his early education in the public schools of that center and attended Swarthmore and Pennsylvania state university. In the interim between completing public school and entering college he served two years' apprenticeship with the Standard Steel Works, Burnham, Pa., as a machine shop apprentice. After leaving college he became identified with the Solid Steel Casting Co., Chester, Pa.

Two years later he accepted employment in the erecting department of the Baldwin Locomotive Works, Eddystone, Pa., returning to the Solid Steel Casting Co. in 1909. In 1910 he was employed as salesman by the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., advancing to the position of assistant general manager, and in 1919 he was made vice president and general manager, a position which he still occupies with the Birdsboro company. He holds membership and is active in the American Foundrymen's Association, the Iron and Steel Institute, and the American Society for Testing Materials.

Reading, Pa.; two-year term, William Faison, Atlantic Steel Castings Co., Chester, Pa.; one year term, G. R. Casey, Treadwell Engineering Co., Easton, Pa.; directors Central Atlantic division, three-year term, H. J. Koch, Fort Pitt Steel Casting Co., McKeesport, Pa.; two-year term, Clarance W. Howatt, Pittsburgh Steel Foundry Corp., Glassport, Pa.; for year, E. B. Powell, Mesta Machine Co., Pittsburgh, Pa.; directors Midwest-Southern division, three-year term, S. W. Utley, Detroit Steel Casting Co., Detroit, Mich.; two-year term, J. T. Osler, Hubbard Steel Foundry Co., East Chicago, Ind.; for year, L. S. Peregoy, Sivyer Steel Casting Co., Milwaukee.

Directors of the Mid-Continent and Pacific coast division were not selected at this time.

Many interesting highlights were shown in the report by Mr. Rogers. He noted that the steel castings industry comprises about 340 foundries, with points of greatest concentration in the following districts: Pittsburgh, Milwaukee, Chicago, Cleveland and Ohio, Buffalo, Eastern Pennsylvania, Detroit and the Pacific coast states. The estimated output of these foundries is about 2,000,000 net tons, while operations have been in the vicinity of 55 to 60 per cent. The annual sales value of the product is from $150,000,000 to $175,000,000 with an invested capital exceeding this figure. Exports of steel castings total about 8,000 tons valued in excess of $2,000,000.

Expansion of present output is impossible, according to Mr. Rogers, without unusual group effort along the lines of better merchandising, research to improve product and the pioneering of new uses. He searched the field for existing abuses which are detrimental and classified them in order of their rank and importance as follows: Price cutting, ignorance of costs, pricing or volume production, granting unwarranted concessions, suspicions and non-cooperation, over capacity, selling by schedules and by the pound, poor merchandising, dumping and piracy of markets, inferior products and others grouped as miscellaneous.

Mr. Rogers recommended setting up both trade customs and trade practices, sound costs, intensive and enlightened group action and better public relations through advertising and publicity as the remedies for these conditions. Cooperative advertising was strongly urged Mr. Rogers stating, "Added impetus is given by undertaking collectively an informative and constructive advertising campaign through the publicity department of the society, through industrial papers and by direct-mail, to tell the world of progress made and new uses found for the product, and the ability of the steel foundry business to serve industry as a whole. The result of this work should be more satisfied customers and consequently better service to the public, greater prestige, acceptance and general use of steel castings, as well as new uses, all of which will provide a larger market for the individual foundry and the entire industry."

Enthusiasm in the acceptance of the plan was indicated by the expressed intention of many firms represented, but not members, to join in the work of the society as outlined.

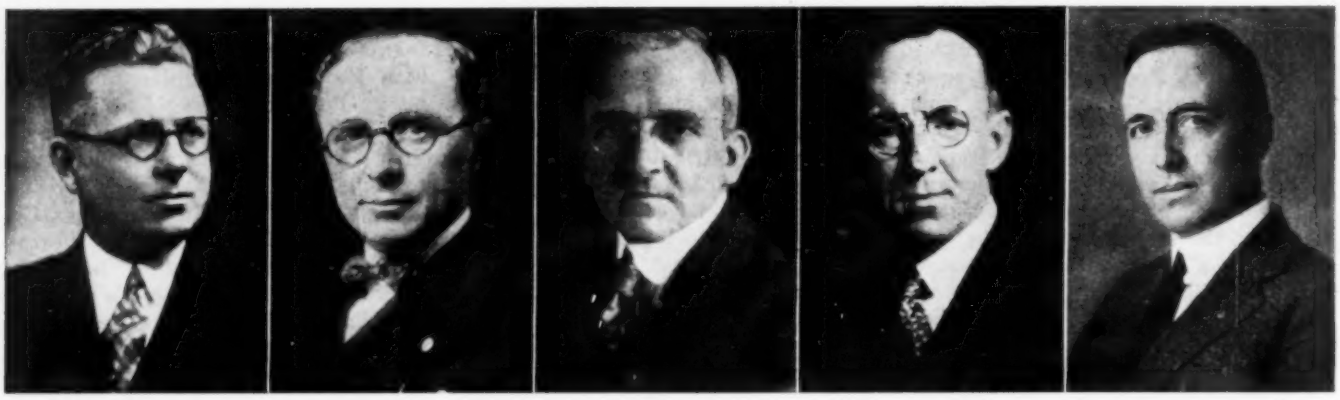
Group meetings of the light and heavy work divisions of the society were held immediately following the adjournment of the general session. An invitation luncheon to representatives of the technical, business and trade press was held Oct. 30, with Mr. Rogers presiding.

Smith & Richardson Mfg. Co., Geneva, Ill., manufacturers and jobbers of chaplets and foundry specialties, is erecting a brick and steel addition to its plant. The new addition will be 40 x 48 feet.

Elects Four Members of Nominating Committee

The 1930 nominating committee of the American Foundrymen's association was completed recently with the election of four members by a letter ballot of the association membership, returned Nov. 4. The following were elected to the committee: M. J. Evans, vice president, Whiting Corp., Harvey, Ill.; R. J. Doty, plant manager, Reading Steel Casting Co., Reading, Pa.; Wm. J. Grede, president, Liberty Foundry Inc., Milwaukee; T. H. Addie, president, American Manganese Bronze Co., Philadelphia.

In addition to four members elected annually, the by-laws of the association also provide that the nominating committee shall include the last three living past presidents of the American Foundrymen's association.



G. P. Rogers | J. E. Galvin | W. H. Worrilow | A. Simonson | E. H. Cornelius

The past presidents thus automatically members of the 1930 committee are A. B. Root Jr., Hunt-Spiller Mfg. Corp., Boston, senior past president and chairman of the committee; S. W. Utley, Detroit Steel Casting Co., Detroit, and S. T. Johnston, S. Obermayer Co., Chicago.

A meeting of the 1930 nominating committee will be held shortly after the first of the year. At that time the committee will consider suggestions from members of the association as to candidates for officers and directors.

Open New Office

By-Products Recoveries Co., Inc., New York, manufacturer of dust collectors, has opened an office at 608 South Dearborn street, Chicago. Frank Trott is in charge of the Chicago district.

Chain Belt Co., Milwaukee, will take over the foreign distribution of steel masts and towers manufactured by the Archer Iron Works, Chicago.

FIG. 1—SAND BED READY FOR THE PATTERN

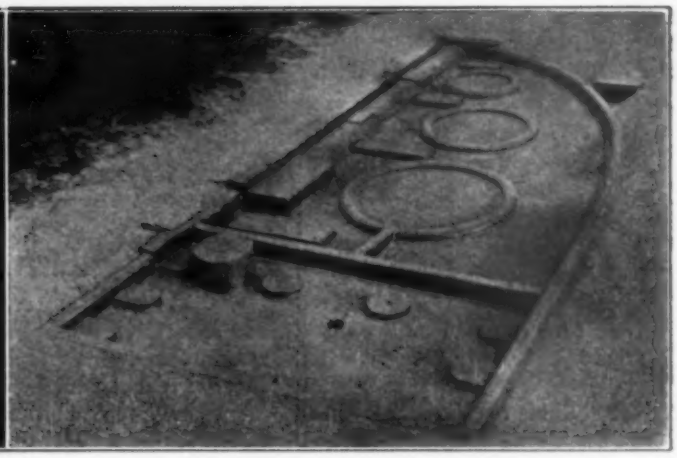


FIG. 2—PATTERN IN PLACE WITH PARTING MADE

Mold Planer Side in Floor

By R. H. Palmer

THE accompanying illustrations show several stages in molding an upright for a planer. Fig. 3 will answer for pattern, although it is an illustration of the casting. A fairly coarse sand known as No. 2 Albany was used in this instance. A bed of sand was prepared in the floor and the pattern was laid on it. This gave the general shape of the pattern on the bed of sand. The pattern then was staked around as shown in Fig. 1 and removed. The ribs on the pattern, left their impression on the face of the bed on the removal of the pattern. Before the pattern was removed it was rapped down lightly. Wherever the pattern ribs rested, the sand was cut down. This bed was well vented, and covered to a depth of 1-inch with facing sand, mixed 1 part seacoal to 9 parts sand.

Parting compound was dusted over the sand to keep it from sticking to the pattern. The pattern was replaced and rapped down level and firm. The sand was rammed around it and the parting was made for the cope as shown in Fig. 2. The cope was placed and gaggered and rammed in the usual manner. Fig. 4 shows

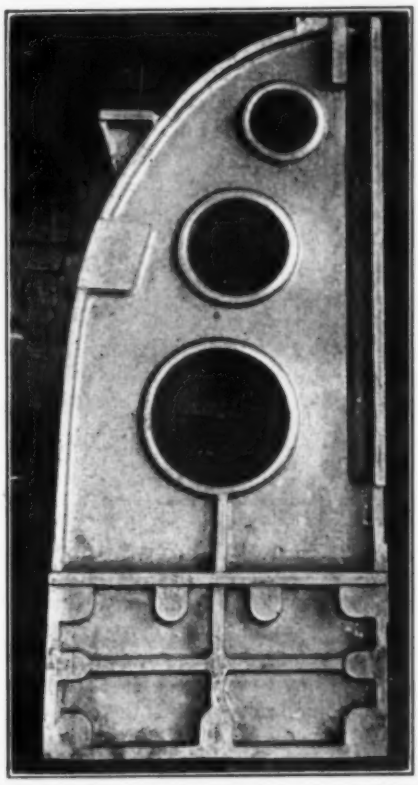


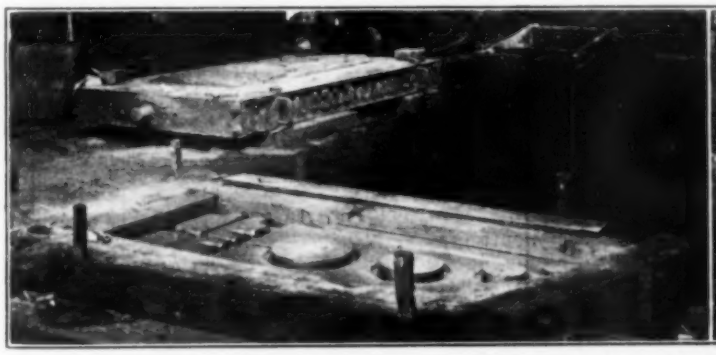
FIG. 3—THE CASTING FOR THE PLANER

cope removed and turned. That part of the casting on which the cross bar of the finished machine moves up and down, the part shown as one looks at the right side of the mold from the top or narrowest part of the mold is finished and must be perfect. The gates are shown at the foot or opposite end of the mold.

A good rule in gating castings is to gate as far from a finished part of the casting as possible. If gated on the machined part, the first rush of metal into the mold may carry some dirt with it and this dirt will remain lodged in the finished part of the casting. If gated away from the finished part, the iron will flow into it easily and a clean surface is the result.

Make an open mold of some length on the floor and watch the iron flowing into it from one end, you will notice as the iron flows along that the cleanest iron will be the farthest from the point the stream enters.

If the pattern is placed on a board and the mold jolted it is better to have a slightly deeper drag than where a sand slinging machine is employed. With either, the saving in cost of molding over the hand ram-



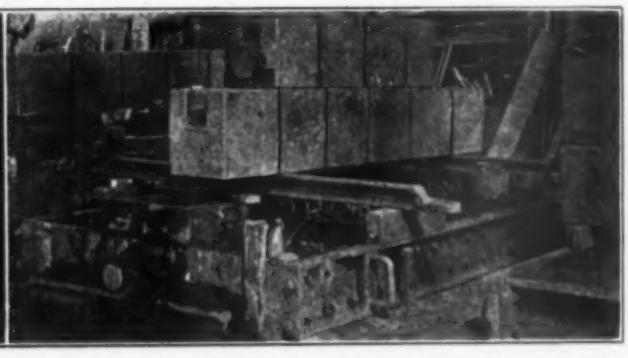


FIG. 4—COPE ROLLED OVER AND PATTERN REMOVED FROM FLOOR. FIG. 5—MOLD WEIGHTED AND READY FOR POURING OPERATION

ming in a flask or bedding in the floor will amount considerable, especially if many are to be made. In a jobbing foundry where only one or two are to be made the molding cost is much greater if the shop has not modern appliances. Fig. 5 shows the mold properly weighted and ready to be filled with molten metal.

Must Educate Foundry Personnel

By J. A. Davies

IT IS difficult to appreciate that there is more discussion on the subject of apprentices in the foundry than in the other branches of the metal working industry. However, it is true that the average foundryman of the past two decades has been hard to convince regarding the need, not only for training apprentices, but for training a different kind of apprentice and training him in a different way.

It has not been so long since that jocular expression "the foundry is no place for a man with brains" was common and contained a modicum of serious belief. Not longer than six years ago a foundryman of considerable experience said in all seriousness that a technical graduate was unwelcome in the foundry and would be wasting his time.

Those interested in the foundry appreciate not only the possibility of its product but realize the effect of the rapid adoption of substitutes. They understand the need for well trained men in our foundries if they are to maintain themselves as the largest contributors of material to the machinery builders' art.

The general method by which many older foundrymen received their practical training must undergo changes by the force of modern circumstances. Acquiring foundry knowledge by rule-of-thumb methods must go, as it has had to go in all other progressive industries. Until a few years ago, engineers and schools of higher engineering education devoted practically all of their skill to the advancement of engineering design and, to a lesser degree, machine shop practice, but largely neglected the foundry. For that reason, foundries have been struggling against heavy odds.

It has seemed as though designing engineers, in their endeavor to obtain lighter weights, lower costs and quicker deliveries, were doing their best to eliminate castings from machine designs wherever it was practicable to use a substitute construction.

As long as engineers found it necessary to use castings, insufficient heed was given to their complaints. Now, the availability to the designer of substitutes for many castings has forced the foundrymen to realize that a great advance must take place in their industry; uncertainties must be replaced by certainties; facts must be ascertained and a course of logical procedure laid out based upon those facts.

One of the most important elements in this situation is that of adequate training for the foundry personnel. It would do little good to put in the most modern sand handling equipment, the finest cupolas, the most up-to-date methods for cleaning castings and all of the other advantages so rapidly becoming available, unless the people directing these many activities are not only in sympathy with them, but are equipped mentally to appreciate their significance, and to utilize them to the limit of the possibilities.

Not long ago an apprentice in the foundry was an exception rather than the rule. The customary practice in the district where I worked for many years was to bring into the foundry as a molder's helper a muscular individual, often speaking broken English, and none too well equipped mentally, largely due to his schooling having ceased at a low grade. By association with the other men in the foundry, he became familiar with the work and in due course was made a rammer. Later on, and particularly when a business boom occurred and molders were hard to get, he was given simple molding operations to do, finally working up to the point where he was rated as a regular molder.

Such men, and there were many of them in the past 25 years, were handicapped greatly by lack of education and training. They found it difficult to diagnose accurately the troubles encountered, and, unaided to a considerable degree by any of the scientific work that was being so freely given to designing and machining, they had to resort to a trial and error method in overcoming the more obscure cases.

Keenness of competition and the insistent demand for better product at lower prices has forced to the front the need for the utmost in the way of skill in our foundry work. Foundrymen are training apprentices for the sole purpose of injecting young and virile men with alert brains into the foundry force, who have been taught to reason cause and effect and to apply the common rules of science that have so largely contributed to the success of other branches of industry. These young men are being watched carefully, and their progress in the trade followed and a record kept of men who possess the qualifications of supervisors. High school graduates are given preference because their larger store of knowledge, particularly in mathematics and English, will enable them more readily to deduce facts and then put them into clear expression. Foundrymen must realize that they must train future foundrymen to the limit of their ability to maintain their place among the industries of the world.

Needs Trained Men

FOUNDRY personnel must be trained if that industry is to keep pace with the other metal working industries of the country. Training methods of former days must give way to scientific procedure and the rule-of-thumb training methods must go. The author of the article, which was abstracted from a paper presented at the Chicago convention of the American Foundrymen's association, April 8 to 11, is general superintendent of the South Philadelphia works of the Westinghouse Electric & Mfg. Co.

Recently the bureau of standards published a pamphlet presenting data on calibrating thermoelectric temperature scales based on the freezing points of antimony, silver and gold as adopted for the international temperature scale. This pamphlet is research paper No. 99 and is entitled, "Thermoelectric Scales." The price is 5 cents and may be obtained from the government printing office, Washington.

The FOUNDRY Family Photograph Album

Upper Left

C. E. WILSON

Wilson Foundry & Machine Co., Pontiac, Mich.

Lower Left

J. R. McGIFFERT

Clyde Iron Works, Duluth

Upper Right

G. L. CANNON

Berkshire Mfg. Co., Cleveland

Lower Right

R. C. ZANNOTH

Roberts Brass Co., Milwaukee

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

HINTS FOR THE CORE ROOM

By O. W. Potter

(*Continued from Data Sheet No.* 786)

fore that an ample supply of oxygen be supplied to develop the bond. This requires an oven with good draft and air circulation. The bond is destroyed at a temperature between 600 and 700 degrees Fahr. and care must be taken that temperature of oven be kept below this.

Mixing instructions:—Add oil to sand and mix thoroughly 2 to 3 minutes, add about 8 per cent tempering water and continue mixing 3 to 5 minutes longer. Certain types of sand are reported to respond better to the bond if tempering water is added first, but in general it is better to add bond first. Thorough and complete mixing is necessary to get the proper distribution of bond. Sand, binder, and tempering water should be measured accurately, and mixing should be done in a mechanical mixer.

Use:—Linseed oil cores can be used on practically all classes of work, but are especially adaptable for small and intricately shaped cores. Because of the difficulty of drying large cores made from all oil sand mix, an oil sand facing is used with a pitch sand backing. Linseed oil cores are almost entirely moisture proof and therefore can be used in molds which are required to stand a considerable time before pouring, or can be kept in storage a considerable time before using. Linseed oil cores clean from castings readily.

Core mixtures:—Linseed oil when used with a clean open sand can be used to the ratio of from 1 to 50 to 1 to 100 by volume. Excessive fines, clay bond, lime, and alkalies in the sand greatly reduce the effectiveness of the bond and with such sands bond ratios are reduced to from 1 to 25 to 1 to 50.

Compounded Commercial Core Oils

Specific gravity:—Approx.—0.9, average weight per gallon—7.5 lbs.

Composition:—Commercial core oil are a mixture of various oils usually using linseed oils as a base. These various oils are added as driers, fillers, spreaders, and catalysts with the idea of producing a combination that will be less viscous, easier to manipulate, and at the same time give a bond value that is commensurable with linseed oil at a lesser cost. Linseed, chinawood, cotton seed, sunflower, and other vegetable oils along with whale and fish oils are considered drying oils. Petroleum, tar, and rosin oils are used as fillers and spreaders. Fish oils practically have been eliminated because of the repulsive odors produced during baking and casting, and chinawood and soya bean oil are used seldom because the source of supply is rather uncertain. The oils employed as fillers are used primarily to reduce the viscosity and to accelerate the distribution of the bonding con-

(*Continued on Data Sheet No.* 790)

HINTS FOR THE CORE ROOM

(*Continued from Data Sheet No.* 789)

stituents of the mixture. Manufacturers of commercial core oils claim that properly blended they are more efficient and economical than pure linseed oil. *Lack of uniformity* in the commercially blended oils is the greatest difficulty encountered, but the modern methods of compounding and scientific control are reducing this condition to a great extent.

Baking conditions are similar to those for linseed oil. The recommended baking temperature is 450 to 500 degrees Fahr. with relatively slow drying. The dry bond is developed by the oxidation of the oil at the baking temperature and therefore an ample supply of oxygen is necessary to develop the bond. This requires an oven with good draft and air circulation. The bond is destroyed at a temperature between 600 and 700 degrees Fahr. and care must be taken that no part of the oven reaches this temperature.

Mixing conditions are as follow: Add oil to sand and mix thoroughly 2 to 3 minutes. Add about 8 per cent tempering water and continue mixing 3 to 5 minutes longer. Thorough and complete mixing is necessary to get the proper distribution of bond. Sand, binder, and tempering water should be measured accurately and mixing should be done in a mechanical mixer.

Use: Compounded core oil can be used any place where linseed oil is used. It is used extensively on nearly all classes of small and medium work for brass, malleable, cast iron, and steel castings. It is used on motor castings such as cylinder jackets, cylinder heads, manifolds, and pistons, and also for radiators, plumbing fixtures, etc. There are many grades and makes of core oils and care must be taken to select the proper oil for the work at hand and then to insist on uniformity. Confer with the service department of the manufacturers freely as they are concerned more than any one that their product give the greatest satisfaction. Do not change from one grade or make of oil without investigating carefully the properties and behavior of the new product. Much trouble and expense invariably results if this precaution is not taken.

Core mixtures: The higher grade core oils may give practically the same bond ratio as pure linseed oil. Open clean silica sands give the best bond ratios and will range from 1 to 50 to 1 to 100 by volume. Excessive fines, clay, lime, and alkalies in the sand greatly reduce the effectiveness of the binder and reduce bond ratios of from 1 to 25 to 1 to 50. This clearly shows that the condition of the sand greatly effects the bond ratio.

Paste Binder

Wheat Flour

Specific gravity: Approximately 0.6, average weight per gallon 4.5 to 5.5 pounds.

(*Continued on Data Sheet No.* 791)

Bill Discusses Seven Cardinal Sins

By Pat Dwyer

THE dove of peace and her sister doves—if she has sisters—of comfort and content, folded her or their wings the other night and perched on the mantelpiece, while Bill and I smoked a comfortable and soothing pipe in front of an open fire. A gentle warmth permeated the air. Wreaths of tobacco smoke floated lazily upward, grateful to the nostrils as the incense burned before heathen idols by those who may be mistaken according to occidental views but who certainly have a right to their own opinions.

'Twas an hour for toleration, for charity to all and malice toward none. An hour when the petty irritations of the day are forgotten and even the grievous offenses fade from a bold, brilliant black to a brown, or even to one of the many shades of gray. One of those hours when a man well fed, warm and comfortable is willing to let down the bars and extend a willing hand for the olive branch, irrespective of who offers it.

We are passing through the world for the last time, therefore what's the use or the sense of starting new quarrels or perpetuating old ones. Nothing is to be gained by dwelling on the memory of old feuds, of real or fancied wrongs, slights or insults. Forget 'em. Bury the hatchet, that's the idea. Bill lounged lazily back in his chair, legs crossed at ease and with a disreputable old pipe clinched firmly between his able teeth. At periodic intervals, without the slighest apparent effort and without removing the pipe from his mouth he spat accurately in the center of the fire. 'Tis a gift like the ability to wag the ears or play the flute and is enjoyed only by a comparatively small number of fortunate individuals. He sat there so peaceful and quiet, eyes staring straight into the fire and with only the gentle and regular rise and fall of his vest to indicate that he still had a hold on the string of life, that I began to wonder what he was thinking about. In all probability, I reflected, his mind and mine are running in the same groove. He is resolving to be more tolerant toward the faults of others in the future. He will not take offense so readily and he will clean all former scores from the slate. Let bygones be bygones and start off the morrow with a clear conscience, a quip and a jest, instead of a hangover and a chip on the shoulder. Good old Bill, I thought, a rough exterior but a heart of gold.

Ah! Well, we all make mistakes. Apparently my forte is not mind reading.

"Supposing," Bill remarked in the tone of one who has considered the subject carefully, "supposing all your pet enemies were lined up in front of you and you were allowed the blessed privilege of flinging bricks at any three of 'em, which three would you select? From which three would you derive the greatest pleasure in scoring a bull's eye?"

"Great Scott, man," I ejaculated in surprise, "you have taken me completely off my guard. Here I have been comparing you mentally to a drowsy old pussy cat purring before the fire and all the while you have been sitting by the rat hole with claws sharpened, conjuring up images of battle, murder and sudden death. Is that nice, I ask you?"

"Sure," Bill replied calmly, "Why not? Next to actually putting the back spot on some of those birds—two black spots, one under each eye—I know nothing that gives me greater pleasure than a mental rehearsal of the ceremony. In fact, on mature consideration I believe I derive more pleasure from contemplation of the deed, than I would from actual realization. When the work is done, it's done, but before you pull off a little job of that kind you can turn it over in your mind 40 times and lap up the full flavor each time. Now I known one snoopy snipe—"

"Bill," I said, "That's no line of talk to hand out on a peaceable night like this. Offhand I can't just remember the full list, but I am reasonably sure your promiscuous remarks lay you open to indictment as a perpetrator of one of the seven cardinal sins."

"Peace," Bill replied with a contemplative wave of one hand. "Peace is my middle name." He shifted his position slightly, recrossed his long legs and spat with his accustomed ease and accuracy. "If I was an argumentative person, which thank heaven I am not, I could knock your statement galley west and crooked and back into the tall timbers. Let me refresh your memory: Pride, covetousness, lust, anger, gluttony, envy and sloth. Which of these cardinal sins could you indict me under? Why, none of them my lad and you can lay to that! If I was so minded I could prove to you that I am one of the boys to whom the beatitudes apply: Blessed are they who hunger and thirst for justice, for they shall be filled. If you want to go back to the beginning of all laws, what about that sprightly little

FIG. 1—IN DARKNESS AND SMOKE

FIG. 2—THE MOLDER AS A LABORER

statute of exacting an eye for an eye and a tooth for a tooth?

"However, that's neither here nor there, as the tramp remarked, scratching his head. Your ill advised reference to the seven cardinal sins reminds me of a package of seven pictures recently sent me by a friend on the other side who attended the foundry congress and exhibition put on by the German foundrymen in Dusseldorf. They are copies of seven large paintings which adorned the walls in one of the halls and which, as I readily can believe, attracted a great deal of interest and favorable comment. Here, take a look at 'em. In the original they are listed as 7 *Hauptsunden der Giesserei* with a couple of dots over the *u* in *sunden*. 'Tis a great language, the German. When I was a young gossoon in the catechism the term seven cardinal sins, carried no terror to my mind. Cardinal was associated in my mind with a large important person in a red robe and scarlet hat and I vaguely assumed that he had something to do with these particular sins. Certainly they were out of my class. Why should I worry about 'em?

"If I had heard them called *Hauptsunden* by a burly teacher with a deep bass voice I would have realized the full significance. Cardinal sins did not frighten me, but if I heard them described as hop sins I immediately would have a vision of the Old Boy waiting to hop on me with teeth and claws and to sting me with his poisoned tail, before he dragged me away to his lair."

"Unfortunately," I pointed out, "my acquaintance with the German language is slight, but I know enough to know that *haupt* is not the same as our word *hop*. It means high, or great and in that way it corresponds with our word *cardinal*. What's the idea of dragging theology into the argument? Theology and the foundry do not mix." "Is zat so?" Bill inquired loftily. "S a y, young-feller-me-lad, I have heard more theological arguments in the foundry than I ever heard elsewhere. I had to fire two bums last summer because they got in a rough and tumble clinch over the proper wording of the Lord's prayer. One championed the 'Forgive us our trespasses' while the other held out for the 'Forgive us our debts.' I tied a can to each of 'em and told 'em to look elsewhere for their daily bread.

"Anyway, *haupt* sounds like hop.

FIG. 3—FEW MOLDS IN, MUCH HEAT OUT

Hop off the twig and throw your eye over this collection of pictures. The lad who sent them to me wrote that the educational feature was stressed heavily in the exhibition and these pictures were designed to show how grievously some foundrymen sinned in their daily practice. In this connection it is interesting to note that foundry practice is fairly universal and the pictures apply to some American foundries as fully as they do to some of the shops in the Fatherland. Look at the first one: *In Dunkelheit und Dunst*, In Darkness and Smoke! The air is filled with smoke from the poured molds, from an open salamander burning coal or coke and from the evil smelling little oil burning lamps in the hands of the molders. These lamps are about the shape and size of the one carried by Diogenes in his memorable search for an honest man.

"He never found him and that is no cause for wonder. By the time he carried the lamp half a mile his face would be covered with such a coating of soot that all honest men would shun him as they would shy away from the devil or any other blackguard.

"Laws of safety, sanitation and the selfish interest of the insurance people long since have banished these horrible little objects from every industry except the foundry. The smoke poisons the air in the vicinity. The flame flickers to every breeze that blows through the drafty old building. Bring your face within two feet of it and the flame curls up lovingly and frizzles your hair—if you have hair. If not it raises a blister. The oil leaks over your clothes and your hands to such an extent that if you are struck by a good, healthy spark you will have to jump in the water barrel. The wick requires constant trimming with a vent wire. If you neglect it for five minutes it sneaks down into the spout like a frightened worm. All the king's horses and all the king's men can't bring it back again. You hit the lamp a belt against the edge of a flask and the only result is a squirt of oil in the eye. The wick disappears and is lost as completely as the Ten Tribes of Israel. Throw your glims once over the gent floating in the upper right of the picture daintily holding his beak. According to all accepted authorities Auld Reekie should be accustomed by this time to all kinds of smoke and heat, but apparently the atmosphere of the

FIG. 4—20 PER CENT COKE AND YET DULL IRON

foundry is too much for even his hardy constitution.

"Ever since a gifted bird coined that famous phrase of a bat flying out of a certain place that shall be nameless, the simile has been accepted as the apex of speed. The coiner never visited a foundry. No one ever saw a bat flying out of one of these smoky dumps. If a bat inadvertently flew into one he would drop dead before he could turn around to fly out. The only creatures who can exist in such a foundry are the rats who creep around eating the flour and licking up the molasses and the molders who creep around the floor on their hands and knees where the smoke is a trifle thinner than it is higher up.

"The second picture is entitled: *Der Former ais Hilfsarbeiter*, The Molder as a Laborer. The Old Boy is perched comfortably on an idle molding machine. A molder's bench on the opposite side of the gangway also stands idle while the molders give a lifelike imitation of beasts of burden. Here is one lad pushing a wheelbarrow load of sand, while two hump-backed specimens are dragging an empty flask in from the yard where they probably had to dig it out of a snow bank. A molding machine is an ingenious contrivance, designed to relieve the molder of a great deal of manual effort, while at the same time increasing the output of molds. Unfortunately—like a lazy molder—it will function only when it is pushed. While the man is prowling around the shop looking for sand, flasks, bottom boards, nails, chaplets and patterns, the machine sits there eating its head off in overhead expense and depreciation.

"Foundry owners watch the markets closely and endeavor to take advantage of fluctuations in price of metals and miscellaneous materials. If one of them picks up a paper in the morning and sees iron quoted at $20 a ton he will denounce as a robber, a salesman who calls in the afternoon and tries to sell him a carload at $20.15. This same man pays his molders from $7 to $8 a day and calmly watches them spend half their time doing work which could be done just as efficiently by common labor at a daily wage ranging between $3 and $4.

FIG. 7—THE "CLEAN" FINISH

"Cardinal sins!" Bill commented, "That artist lad had the right dope. Le's see how he handles No. 3 on the list: *Wenig Formen hinein Viel Warme Heraus*! Few Molds in; Much Heat Out! Few molds, is right! Here you see a lad with three huge ovens and three big cars, each one capable of handling a stack of locomotive frames and all he has is a few molds that a man could dry in half an hour with a plumber's torch. In fact, it is doubtful if the molds need to be dried at all. With a proper grade of sand, many molds that are dried could be poured in the green state. Probably at some time in the remote past, a molder made these castings in green sand molds and found them scabby, or blistered, or pockmarked or porous. '*Dunder and Blitzen!*' the old man raved, 'This monkey business out must be cut. In dry sand them make.' Ever since they have been made in dry sand molds with all the attendant expense when a little investigation and manipulation would have produced them just as satisfactorily in green sand. Dry sand molds have their place and in some instances are a necessity, but frequently they are simply the result of ignorance and lack of initiative. At one time dry sand molds were considered essential to the production of automobile cylinder blocks. Today—at least in American foundries—the universal practice is to pour these castings in green sand molds. However, these intricate castings are not poured with dull iron and the iron is not melted with the kind of coke shown in Fig. 4, 20 *Prozent Koks und doch Mattes Eisen*, 20 per Cent Coke and Yet Dull Iron! you could shovel that mushy rubbish into the cupola until it was filled to the charging door and you would not get hot iron. The falsest kind of false economy is the attempt to melt iron with an inferior grade of coke. You save a dollar or two on a ton of coke and lose $40 in castings. The peculiar and aggravating feature is that the foundryman blames the melter, the cupola, the foreman, the molders and the sand for all the dirty, missrun and wormy castings when the fault lies solely with the coke that is not fit for metallurgical purposes. I think that is the most cardinal of all the red hot cardinal foundry sins. No wonder the devil curls his tail in glee!

FIG. 6—WHAT! ANOTHER WASTER?

FIG. 5—THE OLD WAY IS NOT ALWAYS GOOD

"Look at him in the next one, bearing down with all his weight on the double shank borne by the poor plugs. *Bild* 5, *Nicht Immer Ist Das Alte Gut*. The Old Way Is Not Always Good. Isn't it the truth, Dearie! Three men dragging a 200-pound

(*Concluded on Page* 983)

Training Foremen

Presents Important Problem to Industry

By A. B. Pierce

THE growing significance of and necessity for foremanship training in manufacturing industries has created a rapidly enlarging field for constructive service by forward-looking trade associations. Much valuable assistance may be rendered member companies first by helping them to see the necessity for this work, and then by assisting them to select and install a program that is adapted to their requirements.

A broad statement, but nvertheless one which probably will not be challenged, is that no one activity has even been so far-reaching in the field of employer-employe relations as the present foremanship training movement. The light has not been hid under a bushel, and many plans, services, and courses have been prepared by numerous publishers, privately owned schools, industrial service corporations, and professional writers. Most of those engaged in the work are conscientious; but, unfortunately, unscrupulous persons also have been attracted to the field because of the possibilities for great profit presented to professional writers. Because of this condition, extreme care is necessary when an employer decides which will be the most effective plan to adopt for his establishment. Should a trade association elect to serve its members only in an advisory capacity, there is an unlimited opportunity to help them avoid unsatisfactory experience and loss of money.

Explains Activities

Experience of the National Metal Trades association is typical from the trade association angle, and a brief resume should be of interest.

About five years ago the association's committee on industrial education made an intensive study of the foremanship training field, including the progress accomplished up to that time. Among the various angles studied were the different methods of procedure that were being followed, existing courses, available texts, and the relative effectiveness of each.

Several definite conclusions were reached, outstanding among them being that unlimited benefits may be derived from a properly set up and efficiency managed program; that the so-called conference plan produced satisfactory results more often than nearly all others combined; that in many instances, the use of supplementary texts or lesson sheets added to the effectiveness of programs conducted under the conference plan; that the text materials or courses available in the open market either were unsuitable for use in metal trades plants or were over-priced and that a complete program should be developed, which should include the necessary text material for continuous plant activity of indefinite length.

From these findings the committee on industrial education of the National Metal Trades association developed a course in foremanship training that has since been supplemented for the continuation of plant programs established.

The course was given effectiveness by provision of a conference leader's manual. The manual is a separate book, containing information and suggestions which the conference leader may follow in organizing and conducting a series of plant conferences. This manual also furnishes the conference leader an analysis of each lesson, suggests questions for discussion, and serves as an aid in planning his programs. This initial course purposely was made elementary and general. This was done to break down resistance on the part of the foremen, many of whom believe they do not need any additional training. It is necessary to create an appreciation of the fact that there still is much for them to learn about their own jobs in the early stages of a training program.

Develops Course

The 52 lessons of the course were developed as a part of five sections which may be classified as follows: Self-analysis, job analysis, handling workers, principles and policies of management, and production methods. These lessons are brief, yet contain the necessary material to stimulate thinking on a given subject under discussion. If the lessons are studied previous to the meeting valuable points usually will be brought out during the conference.

The united support of the management is essential to the successful administration of a foremanship training program. There should exist a spirit of open-mindedness on the part of the management, and constantly improving conditions should be anticipated rather than immediate drastic changes. It should be borne in mind that if the initial program is successful, the foremen may be expected to call for more. This has been the experience in most of the plants studied. The management should be willing to delegate full responsibility for the conduct of the program, either to a small committee or to the conference leader. This procedure provides for flexibility of the program and for greater efficiency.

Entire cost of the program should be assumed by the management. The executive organization plan varies in different plants, but the one most commonly used is known as the manager

Outlines Course

FOREMANSHIP training has come to the fore during the past few years because of the necessity of securing trained men in the foundry industry. Many trade associations have committees functioning on the subject and the National Metal Trades association has outlined a course of instruction to be used for foreman conferences. As a result of intensive study, the committee on industrial education of the previously mentioned association has found several methods that are used with varying success. This article is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association and explains the advantages and disadvantages of various methods of training. The author is director of industrial education, National Metal Trades association.

plan. A works manager, superintendent, personnel director, or someone of similar rank, is designated as manager. The conference leader is directly responsible to the manager and may take advantage of the counsel of an advisory committee, composed of staff experts and a leader or two from the ranks of the foremen.

Should Command Confidence

The conference leader selected should be a man who can command the respect and confidence of the foremen without any exercise of authority. He must be able and willing to deal with all questions in a straightforward and honest manner. He must have leadership ability and be what commonly is known in industry as a high-grade man. Men holding positions as superintendents, assistant superintendents, personnel directors, production managers, and others of this level are best qualified because of their association with the foremen and usually are selected as conference leaders.

Conference groups include all assistant superintendents, department heads, foremen, assistant foremen, and subforemen, both in the office and shop. Prospective foremen and others who are being advanced are included to a limited extent. When there are two or more conference groups, consideration is given to rank, position, and working associations when men are assigned to the various groups.

Experience indicates that 15 to 18 constitute the ideal group. Typical enrollments range from 10 to 20, while eight is the minimum and 25 the maximum group that can be handled satisfactorily. The advantages of the moderate sized group are: better distribution of discussion; better opportunity for the leader to measure his men; better opportunity to develop backward men; good variety of experience; less cliqueing; better sociability and friendly competition. Whenever possible, it is best to hold all meetings on company time, as this assures full attendance, discovers men who are good organizers, develops understudies, and indicates a desire on the part of the management to make the program an activity worthy of serious attention.

The combination plan used in a few instances calls for attendance partly on company time and partly on the men's time. This plan has many disadvantages and should be avoided if possible. Some of the disadvantages are: Doubt exists in the minds of the foremen as to the value the management places upon the program, it keeps supervisors away from their department at quitting time, there is a noticeable uneasiness on account of clock watching which works a hardship on the conference leader, and men are delayed in reaching home.

Meetings held entirely on the men's time also are provided in some cases, and if a meal is furnished by the company, this plan sometimes is more satisfactory than the previously mentioned plan. It promotes sociability and a good feeling for the company. On the other hand, the fatigue element is high, and it might create dissatisfaction in the homes of the group members.

Meetings are held either weekly, every other week, or monthly. The every other week plan seems to meet with most favor. There is time to think over and digest the discussions and records developed in one conference before starting to prepare for the next one; more time is available for preparation for the next conference and there is less danger of the men losing interest in the program than in the case of the weekly plan. Interest sometimes lags where there is a long lapse of time between conferences, and for this reason the monthly plan is not regarded highly.

Length of Meetings

Meetings of from an hour to an hour and a quarter have proved most satisfactory. Limitation of sessions to this length secures snappy meeting and holds the interest of the group, as the members do not tire and the leader finds it easy to stimulate discussion. Another situation which arises where sessions are limited is that many times the subject is unfinished and must be carried over until the next meeting. This permits intermediate thought and additional preparation, which produces desirable results. When sessions are too long, there is a noticeable tapering off of interest and a tendency to tire. If on company time, it keeps the men away from their departments too long at one time; and, if on the men's time, there is danger of creating an undesirable attitude toward the program.

There is considerable difference of opinion concerning attendance regulations. There are certain advantages and disadvantages to both voluntary and compulsory attendance rules. Some advantages of the compulsory plan are: Full attendance; an opportunity to develop the weak man; and an opportunity to spot the reluctant man. Some disadvantages of this method are: A lack of whole-hearted support, a possibility of dissatisfaction, and a lack of honest opinion. Some advantages of the voluntary plan are: Whole-hearted co-operation is assured; it points out the progressive men; and it creates a smaller group, the progress of which is more rapid. Some disadvantages of this method are poor attendance, and lack of opportunity to work on the disinterested men.

Describes Conference Room

A suitable conference room is important. The type of room does not matter if it is comfortable, easily accessible, free from disturbing noise, and isolated from interrupting devices, such as auto calls, telephones, and other signals. The room should be equipped properly with a well lighted blackboard at least four feet by eight feet in size and a larger one is more satisfactory. Comfortable chairs are a necessity, and enough tables for all to find a place to rest their elbows have been found desirable. Limiting the number of visitors at any one time has been found to be good practice. Visits by company executives have a good effect if their stay is limited to five minutes or less.

The use of rules, as such, should be highly flexible, as a conference group does its best thinking when everybody is at ease. The conference leader assumes full charge of the sessions and is responsible for maintenance of order and dignity at all times. The leader's job is to present the subject, clarify it, and help the group to define it properly. He also presents questions for discussion and draws out all available ideas from the group members. He strives for distribution and equalization of discussion and refrains from rendering personal decisions. The good leader always endeavors to make the conference informal and avoids posing as a professor or teacher. Probably the leader's most important obligations are to respect the confidence of the group members, to avoid giving offense to any one, and to prevent gossiping. Following each conference, a conference leader always should prepare a report for the management, which should include only those items that relate to the important points developed during the conference.

Foremanship training in the metal trades is a necessity arising as a result of changing procession in manufacturing, the shortage of skilled help, and the ever broadening scope of the field of employer-employe relationships. In the final analysis the major problems of industry today are: The improvement of personnel; the improvement of quality; the maintenance of production and cost reduction.

Chill Molds Need Dense Structure

Castings of This Type Must Stand Severe Service and Care and Skill Are Required in Their Manufacture—Semi-steel Is Advocated

By James H. Anderson

AT VARIOUS times questions relative to a mixture for chills or chill molds have appeared in the columns of THE FOUNDRY. Since the production of chill molds requires skill, it is believed that other foundrymen may be interested in practical methods to obtain the best results. The author has been making chills for 30 years and has chill molds alive today that have been used from 10 to 50 times a day, 300 days a year for over a period of several years without burning or becoming crooked. A chill containing 25 to 40 per cent steel may outlast a straight gray iron chill 10 and 20 to 1. The mixture to stand the heat and hold its shape must contain 25 per cent steel for medium duty and 40 per cent steel for heavy duty work. Steel scrap used in these mixtures should be railroad rail ends as they have a more uniform analysis than other types of steel scrap. The two mixtures given in the accompanying table should give gratifying results.

Gives Analysis

The first will give an approximate analysis of silicon, 1.45 per cent; sulphur, 0.05 per cent; phosphorus, 0.30 per cent; manganese, 1.50 per cent; free carbon, 2.60 per cent; and combined carbon, 0.60 per cent. The second will give an approximate analysis of silicon, 2.00 per cent; sulphur, 0.05 per cent; phosphorus, 0.40 per cent; manganese, 1.20 per cent; free carbon, 2.80 per cent, and combined carbon 0.60 per cent.

The melting of these mixtures is of prime importance. Melting should be done by air volume and not blast pressure and the stock should be charged on a hot bed and left to soak for at least one hour. In doing this have the bed 8 inches higher than when the blast is put on immediately after the cupola is charged. This 8 inches of coke will burn away by time blast is put on and stock will be where it belongs. This hour's soaking heats the cupola and stock thoroughly and aids in increasing the melting ratio. Fast melting is a factor as it holds the manganese content from reducing, increases carbon and keeps down sulphur.

In charging these mixtures, ferromanganese is placed on the bed first, then pig iron around the sides of cupola following with steel scrap, and car wheel scrap last. Coke between charges should have a ratio not more than 1 to 8. The coke should contain under 0.90 per cent sulphur, and if over, say as high as 1.10 per cent, add 10 pounds of 80 per cent ferromanganese which will counteract this excess sulphur.

If limestone is used as a flux with these mixtures be sure it contains at least 90 per cent calcium oxides or calcium and magnesium oxides. Do not open slag hole until the end of one hour's melt. These mixtures melted under above conditions should give castings of the following analyses: Mixture No. 1, heavy duty; silicon, 1.30 per cent; sulphur, 0.07 per cent; phosphorus, 0.30 per cent; manganese, 1.20 per cent; free carbon, 2.50 per cent, and combined carbon, 0.70 per cent. Mixture No. 2, light and medium duty; silicon, 1.80 per cent; sulphur, 0.075 per cent; phosphorus, 0.35 per cent; manganese, 1.10 per cent; free carbon, 2.70 per cent, and combined carbon, 0.65 per cent.

While either of these analyses could be obtained from a straight gray iron mixture and one will find on comparing a chill mold for a crusher jaw made from one of these mixtures with one from a gray iron mixture with the same analysis that the gray iron chill will be burned up past using whereas the steel alloy or semi-steel chill hardly will show its use even though the same care is taken with both chills.

Light and medium and heavy duty refers to the amount of molten iron running over or into chill mold. Heavy duty would be crusher jaw or plate, heavy balance and heavy sash weight chill molds. Pig iron chills, copper bullion chills and others of like nature also would be included.

Light to medium classification would embrace chills for sand molds of all kinds. This would include all chill molds holding not over 25 pounds molten iron at one cast, or chills to be used in sand molds, small balance and sash weight, chills, under ten pound sash weight, two in a chill, and all medium weight nonferrous casting chill molds.

Use Care at First

A chill mold is like an automobile; it is made or broken on the first run. Any chill mold first should be filled a few times with iron that will be just hot enough to pour the casting in the chill. It is infinitely better to misrun the first few castings in preference to burning the chill. After the first few casts this extreme care is not necessary. However, chill casting of any kind requires eternal vigilance.

Another thing to have in mind is never to disturb the surface of a chill mold that has to take a flow of iron. If the casting is such that the sand surface of the chill mold will not provide good enough surface, make and machine a chill for that part of your chill mold. Chill molds must be smooth enough from the sand heap because if the scale is broken, even by chipping, the chill either is ruined or its life is shortened.

Mixtures for Making Chill Molds

MIXTURE NO. 1—HEAVY DUTY	MIXTURE NO. 2—LIGHT AND MEDIUM DUTY
800 pounds Steel scrap—rail ends	500 pounds Steel scrap—rail ends
600 pounds Charcoal pig iron No. 3	800 pounds Foundry pig iron No. 3 low phos.
600 pounds Car wheel scrap	700 pounds Car wheel scrap
30 pounds Ferromanganese (80 per cent)	20 pounds Ferromanganese (80 per cent)

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Causes of Aluminum Pinholing

Pinholes in Cast Aluminum Alloys, by N. F. Budgen, *Metal Industry*, London, Sept. 27, and Oct. 4, 1929.

An investigation of the cause of pinholing in aluminum and aluminum alloys was conducted by the author. Experiments were conducted on pure aluminum; an alloy containing 4 per cent copper, 2 per cent nickel, 1½ magnesium, remainder aluminum; an alloy containing 13 per cent zinc, 3 per cent copper and the remainder aluminum; alloys containing respectively 12 and 8 per cent copper, remainder aluminum, and aluminum-silicon alloys containing 9 to 14 per cent silicon. The author summarizes his work as follows: "Various types of pinholes are seen in the commonly used aluminum alloys, the form of which depends generally upon the treatment to which the alloy has been subjected in the molten state. This statement applies to the commonly used alloys such as the 13 per cent zinc, and 3 per cent copper; the 8 per cent copper; the 12 per cent copper alloy, and the 4 per cent copper, 2 per cent nickel and 1½ per cent magnesium alloy. The aluminum-silicon alloys behave somewhat differently, and the pinholes seen in them have a rather different form.

"The cause of pinholes is considered principally to be due to gas evolution at solidification, as evidenced by the facts that: Solidification of the alloys *in vacuo* causes marked exaggeration of normal pinholes due to release of pressure and consequent expansion of the gas which causes them. The aluminum alloys which normally show pinholes, when treated in some way to remove the gas, become practically pinhole free. The higher the temperature to which such alloys are raised, the larger to a degree are the pinholes in the resultant casting, indicating absorption of gases. The size and shape of pinholes is influenced by the amount of gas in an alloy and the dispersion appears to be connected with crystal size. The ingot aluminum is shown to be capable of giving rise to pinholes if it is not virgin metal from the best producers: ingot from fine spinnings and wire may cause bad pinholing under certain conditions. Melting temperature and time maintained molten are shown to be the factors of paramount importance in forming pinholes. Gas-firing in reverberatory furnaces appears more likely to lead to pinholing than oil-firing although the reason is not clear in view of the fact that every attempt was made to maintain a neutral atmosphere in the tests.

"The rate of solidification largely influences the extent of pinholing in aluminum alloys which explains the well-known practical means for the prevention by chill-casting or simply inserting chills in sand molds. In the same way, thickness influences the results; thin sand-cast sections in general being freer from pinholes than thick sections. The discovery made by Archbutt that slow cooling is effective in removing gas from some alloys is confirmed. Turbulent pouring is not found to lead to appreciable pinholing. The statement of Tullis that the chlorine treatment of aluminum alloys is satisfactory in preventing pinholes by gas removal is found to be true in some alloys."

Making Strong Cores

Contribution to the Study of Sands for High Resistance Cores, by Stephane de Nagourski, *La Revue de Fonderie Moderne*, Paris, Aug. 25, 1929.

A siliceous sand, as pure as possible, is recommended. The sand should be tested chemically. The object of the article is to suggest a simple method enabling the foundryman to find the proper mixture to make oil cores which can resist considerable stresses, without having to resort to expensive and complicated equipment. The qualities required of the cores are: Resistance, high permeability, good cohesion in the green state; in addition, there should be no deformation during drying or in contact with hot iron, this depending mostly on the core oil.

Experiments were made with two white sands, differing by the diameter of the grain, and linseed oil. Test cores were made, dried and tested as to resistance, permeability and cohesion. The simple apparatus used for these experiments is described, together with the formulas and charts used to interpret the results.

Tests Hydraulic Cleaning Process

Versuche ueber Putzen mit Wasserstrahl, by Prof. U. Lohse, paper presented at the convention of the Verein Deutcher Eisengiessereien, Giessereiverband, held at Duesseldorf, Germany, Sept. 4 to 7, 1929.

The author describes some tests conducted on hydraulic cleaning of castings. The quantity of water discharged by nozzles 0.12; 0.20; 0.25; 0.33 and 0.47 inches in diameter with pressures of 29; 51.5; 66 and 110 pounds per square inch was determined and results showed that nozzles of small diameter with high pressure have lower water consumption. The best results were obtained with a nozzle about 0.28 inches in diameter. Tests also were made to determine the amount of sand removed in a given period by this method. To this end a number of castings were weighed before and after cleaning. One casting was a crankcase which weighed 1144 pounds before and 374 pounds after cleaning while the weight of the core arbor sprayed out at the same time was 70.4 pounds. Cleaning took 42 minutes during which 699.6 pounds of molding material or about 16.7 pounds per minute was removed. The effect of different kinds of molding materials also was determined. Flasks were rammed with ordinary molding sand, *lean* core sand and *fat* core sand, and tried with different water pressures and nozzle sizes. Ordinary molding sand was removed in the shortest period. Lean core sand took about 1.8 times that of ordinary sand and fat core sand about 1.5 times. Oil sand cores were removed as smoothly as molding sands with a 0.20-inch nozzle and 110 pounds per square inch water pressure. According to the author considerable saving in cleaning cost may be obtained in castings of large dimensions with complicated cores through reduction in cleaning time, and that it is not difficult to effect a saving of 40 per cent. A special advantage of the method is the avoidance of dust.

Determines Gas Permeability

Gas Permeability of Molding Sands, by F. Maske and E. Piwowarsky, *Foundry Trade Journal*, London, March 28, 1929.

The authors carried out a series of tests using molding sands containing varying amounts of water, with and without sea coal, and with and without graphite coatings, to determine the effect upon the permeability of the sand. They also varied the casting temperature of the metal. Samples of sand were rammed in a sheet metal ring 4½ inches in diameter and 4⅞ inches high which had a wooden plug at the top to prevent egress of gas except through a tube placed in the center. A thermocouple also was inserted in the sand. This sand specimen is rammed in a mold containing a flat pattern 10½ inches in diameter and 1¼ inches thick. The mold had a gate and a riser. Molten metal was poured into the cavity left by the pattern and the amount of gas given off when the mold was filled was measured.

From the data collected the authors developed several curves to show the effects of the various factors. However, the curves are not of general application, but will allow the determination of the amount of gas given off under certain definite conditions. If the permeability of the sand to be used is determined in the ordinary way, it easily may be ascertained whether the sand will be suitable for making the casting. However, if the permeability as determined is such that it will not carry off the gas generated, conditions may be changed so that there is little possibility of the iron boiling in the mold.

The Shakeout

DAN M. AVEY, *Editor*
FRANK G. STEINEBACH, *Managing Editor*
PAT DWYER, *Engineering Editor*
EDWIN BREMER, *Metallurgical Editor*
CHARLES VICKERS, *Nonferrous Editor*
NORMAN F. HINDLE, *Assistant Editor*

¶ Lift the Curtain

ONE of the many reasons why Charles M. Schwab is such an entertaining speaker is that he does not hesitate to tell a joke upon himself. One of his favorites deals with an early experience in selling rails. He almost had closed the sale when the customer suddenly remembered an important point. He claimed that a competitor had offered him rails with 5 phosphorus (steel men treat the decimal point as the average man treats the letter g) but he would give Mr. Schwab the order if he would guarantee an equally favorable phosphorus content in his product. "Five?" said the redoubtable Chas. "Five phos, did you say? My dear man, none of our rails are down to that. We can give you rails with 10 phos and if you say the word we can run you a special lot with 20."

GRAY iron foundrymen to some extent suffer from this type of well meaning, enthusiastic but technically ignorant salesman. The situation is further complicated by ignorance of technical details on the part of the customer. The intelligent customer loses faith in the flashy salesman's claims. The ignorant customer does not know what physical characteristics or analyses to demand in his castings. Through private enterprise and through technical organizations, work on chemical and physical tests now is being standardized to a point where the best kind of iron for any given class of castings may be specified definitely. Part of the object of various foundrymen's associations is the dissemination of this information, not only to members, but to the public interested in any manner in the purchase of castings. The process is slow, but the leaven is working. Some day the customer will be able to specify exactly what he wants in the way of a certain casting and when that day comes, the foundryman will heave a sigh of relief.

¶ Study Soundness with X-Rays

THE recent installation of an X-ray machine for the inspection of castings in a large nonferrous foundry, has introduced the casting industry to a new tool. In this plant the apparatus is used to inspect airplane castings for internal defects. It is one of the first installations in the country that is used for inspection purposes in the foundry field. The use of the X-ray machine as a routine tool perhaps is far distant but at present it is available for the study of causes of defects in every foundry field including ferrous and nonferrous.

THE installation of the machine has aided that foundry in the solution of many molding problems. Interior defects have been eliminated to a great extent by changing the molding methods for certain castings and the number of defectives has been reduced materially.

A SYMPOSIUM was held last summer at Glasgow, Scotland, under the auspices of the Institute of Mechanical Engineers and the Institute of British Foundrymen at which steel castings were studied with the aid of X-rays. Steel foundrymen have done much to improve their product but more remains to be done. Knowledge of causes of internal defects would aid in the solution of the soundness problem. The X-ray furnishes a method by which such defects may be studied. Steel foundrymen may borrow a page from the notes of nonferrous foundrymen in the application of X-rays to the solution of their foundry problems.

¶ Unfamiliarity Breeds Error

REMEMBER the one about the New York girl on the dude ranch in Arizona who said she didn't care to have a saddle with a horn, because the traffic probably would not be very heavy? Blissful ignorance, coupled with misapplied or wrong information often is amusing, but more often just plain aggravating. The newspaper cub who lets his fancy roam in describing his first visit to the foundry is a familiar figure. The business expert chosen because of his valued outside viewpoint often blunders to his own confusion and the embarrassment of his sponsers. The statistical enumerator who counts foundries and machine shops and lumps them all in his totals makes fact finding difficult. All these blissfully ignorant ones have their shortcomings, but the worst of all is the misinformed teacher or engineer who accepts obsolete data, and who in his state of benighted opinion condemns cast metals of the present under the physical properties of the prewar days.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

WILLIAM J. GREDE, recently re-elected a director of the Gray Iron institute, is president of the Liberty Foundry Co., Wauwatosa, Wis., and the Spring City Foundry Co., Waukesha, Wis. Mr. Grede was born in Milwaukee and attended the University of Wisconsin. He was graduated in 1917 and entered the employ of the Wagner Castings Co., Decatur, Ill. In 1920 he took over the entire assets of the Liberty

WILLIAM J. GREDE

Foundry Co. Later he and his associates acquired the Spring City Foundry Co. and Mr. Grede was elected president of both organizations. He has been active in foundry circles, being one of the founders of the Wisconsin Gray Iron group and is a member of the cost committee of the American Foundrymen's association.

Carl A. Miller has been appointed general manager of the Capitol Casting Co., Lansing, Mich. For the past nine years he served as factory superintendent.

Otto Abel has returned to the Sweet & Doyle Foundry & Machine Co., Troy, N. Y., as foundry superintendent, a position which he formerly held with that company.

E. G. Jones, formerly connected with the Canadian Brake Shoe & Foundry Co. Ltd., Sherbrooke, Que., has been appointed superintendent of the Joliette Steel Ltd., Joliette, Que., manufacturers of steel castings. J. Critchley has been appointed sales engineer for the same company.

Robert McGhie, foreman of the Youngstown, O., plant of the United Engineering & Foundry Co. has resigned. His future plans have not been announced.

A. D. Matheson, French & Hecht, Inc., Davenport, Ia., represented the Quad-City Foundrymen's association on the committee from the Tri-City Technical council which participated in the celebration of "Kewanee Industrial Day", a celebration planned by the Kewanee chamber of commerce, Kewanee, Ill.

Q. S. Snyder has been elected president of the Pittsburgh Rolls Corp., Pittsburgh, subsidiary of the Blaw-Knox Co., to succeed D. L. Eynon, recently deceased. He also has been elected a Blaw-Knox director. Mr. Snyder joined the Pittsburgh Rolls Corp. ten years ago as vice president and has been general manager for three years.

L. A. Dunn has been appointed superintendent of the malleable foundry of the Erie, Pa., plant of the General Electric Co. He formerly was connected with the Eastern Malleable Iron Co., Naugatuck, Conn., at the Wilmington, Del., plant; Laconia Car Co., Laconia, N. H.; Temple Malleable Iron & Steel Co., Temple, Pa.; Acme Steel & Malleable Iron Co., and Pratt & Letchworth Co., both of Buffalo.

C. H. Lehman, secretary of the Blaw-Knox Co., has been elected secretary of the Union Steel Casting Co. to succeed W. C. Eichenlaub, who has resigned to become associated with the Pittsburgh Steel Foundry Corp., Glassport, Pa., as sales manager. Mr. Eichenlaub had been connected with the Union company for 25 years. George Daumbauld, assistant treasurer of the Blaw-Knox Co., has been elected a director of that company.

Henry M. Kelly, general superintendent of the United Engineering & Foundry Co., Youngstown, O., has retired from active duty after almost 43 years of continuous service. He has been succeeded by E. E. Cross of Cory, Pa., formerly with the Carnegie Steel Co. Mr. Kelly entered the employ of Lloyd Booth & Co., predecessors of United Engineering & Foundry Co., at the age of 19 as an office boy. He was advanced steadily until he became assistant manager of the Lloyd Booth plant of the present company.

Arthur J. Speer, formerly connected with the Silver Bay association, Silver Bay on Lake George, N. Y., has been appointed personnel director of the American Cast Iron Pipe Co., Birmingham, Ala. Mr. Speer has been affiliated with the national council of the Y.M.C.A. for

ARTHUR J. SPEER

the past 15 years. He has traveled the Gulf states territory doing cooperative work between the management and the men of the textile, coal, iron and steel industries.

J. B. Deisher, formerly shop practice engineer for the Malleable Iron Research institute, Cleveland, has resigned to become works manager of the Columbia Malleable Castings Co., Columbia, Pa. Mr. Deisher has had a varied career in management and consulting work. He was connected with the Symington Co., Rochester, N. Y. for 14 years and served with the American Malleable Castings association and the Malleable Iron Research institute for 3½ years as assistant to the consulting engineer. He was sent to Europe by the American Radiator Co. in 1927 as consulting engineer in its French malleable

plant located in a suburb of Paris. Previous to his recent connection with the institute, he worked as an independent foundry consultant.

Jan R. Dunsford, vice president of the Lewis Foundry & Machine Co., Pittsburgh, has been elected president of the Union Steel Casting Co., Pittsburgh, both companies of which are subsidiaries of the Blaw-Knox Co., Blawnox, Pa. He succeeds J. P. Allen, who has resigned as president but who retains his directorship. Mr. Allen plans an extended rest before again becoming actively engaged in business. He had been identified with the company for 27 years and served as president and general manager since 1918. Previous to this connection, he was associated with the American Steel Foundries, at one time as superintendent of the Alliance, O., plant. Mr. Dunsford became affiliated with the Lewis company in January, 1928, prior to which time he acted as sales manager for the Wheeling Mould & Foundry Co., Wheeling, W. Va.

Readers Comment

Note—Material appearing under this head does not necessarily reflect the opinion of THE FOUNDRY or of its editors.

TO THE EDITORS:

I have noted in your Sept. 1 issue, the editorial "Need Uniform Brass Ingots."

I think it would be well to answer this editorial by referring to the organization of A. S. T. M. "Special committee on Promotion of General Use of Specifications for Copper Alloys in Ingot Form." As you know, the committee has joint representation by consumers and producers of ingot metals, and trade paper representatives. I refer you to the original meeting held in Cleveland, Nov. 26, 1928. The committee has been active ever since that time and has had splendid co-operation on the part of members of the Non-Ferrous Ingot Metal institute. I expect to call another meeting toward the end of November, and at that time to initiate the first practical steps toward the goal suggested in the editorial.

G. H. CLAMER

Ajax Metal Co.,
Philadelphia.

The regular November meeting of the Wisconsin Gray Iron group was held at Hotel Schroeder, Milwaukee, Nov. 6. H. Bornstein, in charge of the testing and research laboratory, Deere Co., Moline, Ill., gave an interesting talk on some of the problems in cast iron metallurgy.

Obituary

Harry S. Graham, president, Washington Iron Works, Los Angeles, died Oct. 8. He was one of the pioneer foundrymen of Los Angeles and with his brother E. H. Graham founded the company of which he was president.

Alexander L. Schuhl, manager of the Philadelphia office of the Independent Pneumatic Tool Co., Chicago, died on Oct. 8 at an age of 45 years. He formerly was connected with Wm. Cramp & Sons Ship & Engine Building Co., Philadelphia, as foreman of the pneumatic tool room. He resigned that position in 1917 to join the sales force of the Independent company and was appointed manager of the Philadelphia office in 1924.

Arthur F. Hegewald, 62 years old, president and owner of the Charles Hegewald Foundry & Machine Co., New Albany, Ind., died Oct. 19 at his home in that city. He had been sole owner and operator of the foundry since five years ago, when he purchased his brother's interest. The business had been founded by the late Charles Hegewald, father of Arthur and Edward Hegewald. Mr. Hegewald was a native of New Albany and always lived there, taking an active interest in the development of the Ohio river.

Ernest F. Harder, 71, assistant to the vice president, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., died Oct. 13. Mr. Harder was born at Swampscott, Rostock, Germany, Aug. 15, 1858 and came to the United States when he was 25 years old. He secured a position as foreman at the Garrison Alley works of the Westinghouse company and rose by successive steps to general foreman and assistant superintendent of the East Pittsburgh works, superintendent and works manager of the Newark works and finally was appointed assistant to the vice president in 1926.

William J. Stoop, for many years prominent in the steel industry of the Pittsburgh district, died Oct. 23 in his home in that city after an illness of several months. Starting at the bottom in the steel industry 35 years ago, Mr. Stoop worked his way up, first to the general superintendency of the Mackintosh-Hemphill Co., Pittsburgh. Later he became, in succession, general superintendent of the Mesta Machine Co. in Homestead; general superintendent of the Portsmouth, O. plant of the Wheeling Steel Corp.; vice president in charge of operation of the Wheeling Steel Corp., and general manager of the Morgan Engineering Co., Alliance, O.

Francis A. J. Fitz Gerald, past president of the American Electrochemical society and consulting engineer died recently at Niagara Falls, N. Y. He was born in Dublin Ireland, June 1, 1870 and was graduated from Trinity college, Dublin university in 1892. He received degree of bachelor of science from Massachusetts Institute of Technology, Boston, in 1895. From 1895 to 1900 he was chemist for the Carborundum Co., Niagara Falls, N. Y. and from 1900 to 1903 he was research chemist for the Acheson Graphite Co., Niagara Falls. In 1903 he formed the Fitz Gerald Laboratories Inc., Niagara Falls, engaging in consulting engineering work in electric furnace work, electrometallurgy, etc. Mr. Fitz Gerald also published many articles in the technical press. He was a member of the American Electrochemical society, American Institute of Electrical Engineers, Faraday society, Franklin institute, and the American Association for the Advancement of Science.

Midvale Company Enters Alloy Casting Field

Midvale Co., Nicetown, Philadelphia, has purchased the Chrome Alloy Products Inc., Conshohocken, Pa., manufacturers of chrome and chrome nickel alloy castings. The company has obtained the exclusive right to manufacture in the United States patented compositions of chromium and nickel with other alloys held by Commentry-Fourchambault et Decazeville, Paris, France, and also is licensed to produce certain alloy steels developed by Sir Robert Hatfield. T. Holland Nelson has been retained as consulting engineer and in an advisory capacity.

Issues New Folder

Frank D. Chase Inc., 720 North Michigan avenue, Chicago, engineer and architect, recently has published the first addition of a folder called, "The Archineer." The name evidently is taken from the first part of the word architect and from the latter part of the word engineer. In this small folder the company brings before the reader the value of the engineer and architect going hand in hand. Several instances are cited where money has been saved through changes in production methods recommended by its engineers and by places where it has been saved by constructing buildings to fit the process.

Bill Discusses Sins

(*Concluded from Page* 975)

ladle around the shop when one man with a bit of a monorail could shove a 1000-pound ladle around faster and pour off more molds in an hour than the three lads in the picture could pour all afternoon.

"No. 6 marks the ultimate zero in the day's program. *Woker Wieder Der Ausschub?* Why Another Waster? Note the fine look of scorn on the gaffer's face and the woe begone expression of the two unfortunate plugs presumably responsible for the hunk of scrap. They lost the first casting and were prepared with 47 good airtight alibis. The second is a poser and they now are prepared for the worst while still hoping for the best. The old man derives a little melancholy pleasure in peeling the hides off them figuratively, but that is little consolation when the time comes for placating an impatient customer or in meeting the payroll. Also he is on the horns of a dilemma, whether to trust the job again to the two misfits or to risk it with two others.

"The last picture on the list, and believe me list is long enough, shows a couple of unfortunate creatures painfully and slowly cleaning a big casting with a bar and a hand hammer and chisel. The devil very thoughtfully flies away with the pneumatic equipment which would do the job in jig time. The artist sardonically captions this picture *Der 'Saubere' Letzte Schliff.* The 'Clean' Finish! Those two lads also will want an alibi when the customer receives the 'clean' casting!

"They will be in the same boat," Bill remarked with a grin, "as old Angus the chipper slipping out of the shop during working hours to get a little snifter. Suddenly he ran into the boss. 'Hello,' this worthy remarked pleasantly, 'were you looking for me?'

"'Aye,' says brave Angus, 'Ah wis lookin' for ye, but Ah didna want tae see ye!'"

FIG. 2—TWO OF THE NEW MACHINES INSTALLED IN PLANT MAKING BOILERS

Quick Operation Features Molding Machine

The Herman Pneumatic Machine Co., Zelienople, Pa., recently has introduced a new jarr, rollover, pattern draw molding machine which is designed to jar a mold in approximately 20 seconds. The table plate, base and plunger of the jarring machine are steel castings. The table, which extends down over the base of the machine, fits tight to provide a dust proof joint. All compressed air entering the machine is passed through a filtering device.

A sub-base is provided under the jarring machine. Four inches of enclosed cork is located between the sub-base and the jarring machine to absorb the shock that otherwise would be transmitted to the main base and the rollover device. The turntable plate on this machine is 42 inches wide, 72 inches long and the uprights on the turnover plate are 96 inches. These dimensions determine the longest flask which may be placed on the machine.

The equalizer, which is controlled automatically, is an air lock device. Two pattern drawing cylinders provide perfect alignment when the draw is being made. The turnover plate is provided with vibrators and an automatic vibrator starting valve. A side view of the machine is shown in Fig. 1.

The rollover device consists of two side housings assembled on a steel base which also locates the jarring machine at the proper distance. The rolling over cylinder is oil controlled. A double balanced cylinder is used so that both the rolling over and rolling back operations may be controlled exactly. The equalizer also is fitted with roller conveyors. When the mold is at the lowest position, the rollers tilt to an angle of 2 degrees and the mold rolls off on a roller conveyor which carries it to the finishing floor. Two machines equipped with roller conveyors are shown in Fig. 2.

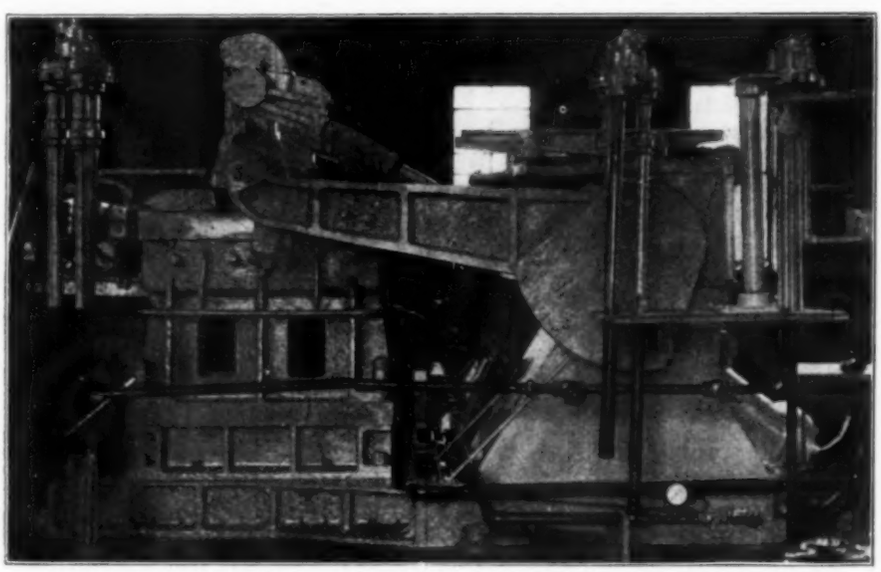
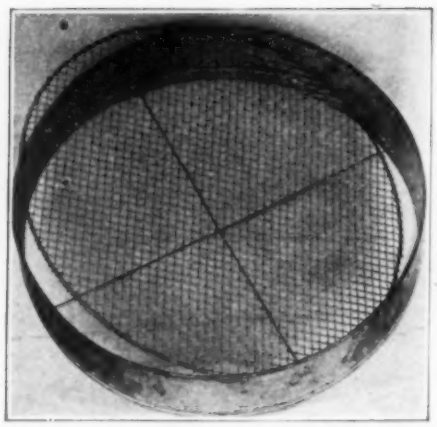


FIG. 1—SIDE VIEW OF NEW MACHINE SHOWING THE JOLTING AND THE ROLL OVER EQUIPMENT

Makes New Type Riddle

Rolock, Inc., formerly De Mattia Wire Works, Southport, Conn., recently has introduced a new type riddle with a metal rim and a removable bottom. The accompanying illustration shows the riddle with the bottom ready to be set in place. It is made in several sizes and a special rim is available for use on gyratory machines. The riddle consists of a sheet steel rim with two wires across the bottom at diameters 90 degrees apart to hold the bottom in position. The rim has an indention around its circumference immediate-



BOTTOM OF THE RIDDLE IS DETACHABLE

ly above the wires into which the bottom fits thus keeping it in place. It finds use on gyratory riddles where the bottoms may be changed with little delay after the rim has been bolted in place. Another advantage of that piece of equipment is that a number of varying mesh bottoms may be kept in storage in a minimum amount of space.

Builds Limit Switch

The General Electric Co., Schenectady, N. Y., has developed a new cam-operated limit switch for industrial control applications. The switch supersedes the various older types which that company has been manufacturing. The new switch is enclosed in a cast case. Electrically it is a two-circuit switch that, by a simple adjustment, can be made either normally open or normally closed, or one circuit open and one closed. It is a snap-action, cam-operated device and can be obtained with either spring or star-wheel return with any one of four operating levers: a roller lever with a 1 or 3-inch roller, a forked lever or a straight lever. The contact tips are interchangeable with those of standard cam-operated master and geared limit switches made by the General Electric Co.

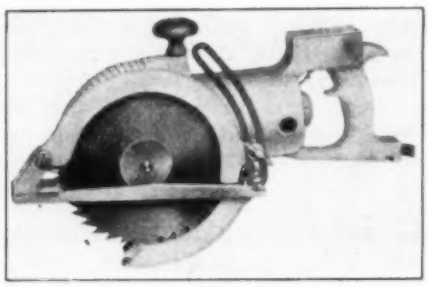
Heads Curtis Company

Walter C. Hecker has been elected president of the Curtis Mfg. Co., St. Louis and its subsidiary companies, including the Curtis Pneumatic Machinery Co., Curtis Saw Co., and Curtis Clutch Disc Co. Mr. Hecker formerly was senior vice president. E. H. Steedman, retiring president retains his place on the board of directors.

Murry Jacobs Co., 554 South Pedro street, Los Angeles, has been appointed representative in the Southern California territory for the Reading Chain & Block Corp., Reading, Pa.

Makes Light Weight Saw

Wodack Electric Tool Corp., 4627 West Huron street, Chicago, recently has placed on the market a light weight, one-hand, electric saw for cutting boards 2⅝ inches thick or less. The tool weighs 15 pounds and is of compact construction featuring a saw dust blower to insure good vision. It is equipped with a trigger switch, momentary contact, rip gage to save marking the board to be sawed and a depth gage easily adjustable by one wing nut. Accessories include a 15-foot extension cord, a one-pound can of lubricant, grease gun, steel carrying case, adjustable depth gage and rip gage.



A DUST BLOWER INSURES GOOD VISION ALONG THE CUTTING LINE

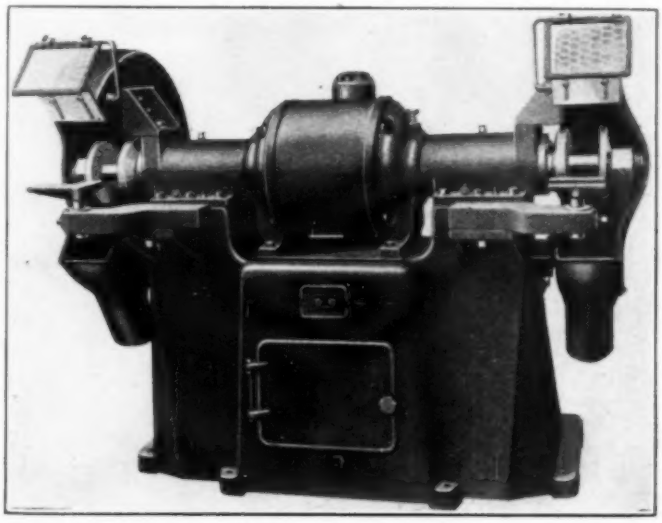
Grinder Is Available in Many Sizes

Hammond Machinery Builders Inc., Kalamazoo, Mich., formerly the Hill-Curtis Co., has placed on the market a new heavy duty, floor-type grinder, shown in the accompanying illustration. The grinders have been designed to give maximum power and rigidity and are equipped with a totally enclosed motor which has an air cleaner, and four oversize, ball bearings mounted on a heavy chrome-manganese spindle. The motor starter is of the automatic type having thermal overload and low voltage protection with push button control. Adjustable, boiler plate, wheel guards with hinged doors, exhaust pipe connection, adjustable spark and chip breaker and eye shields are standard equipment. The guard is adjustable to the wear of the grinding wheel and permits maximum working space with protection to the operator. Motors supplied to the machines are of the totally enclosed type, cooled with an air cleaner and guaranteed to develop the nameplate horsepower rating and to withstand a momentary overload of 100 per cent. The air cleaner supplies clean air to the motor and keeps the dust and grit from the motor windings. High grade ball bearings completely enclosed by double labarinth seals are supplied with each machine. Tapered roller bearings will be supplied if specified. Tool rests are adjustable and removable. The machines are available equipped with motors for 220, 440 and 550 volt, 2 or 3 phase, 25, 40, 50 or 60 cycle alternating current and 110, 220 and 550 volt direct current operation.

A. S. T. M. Will Meet in Atlantic City

The 1930 annual meeting of the American Society for Testing Materials will be held at Haddon Hall, Atlantic City, N. J., June 23-27, according to a decision of the executive committee reached on a meeting October 8. The 1931 meeting of the society is scheduled for the Stevens Hotel, Chicago, June 22-26. The new Haddon Hall at Atlantic City is large enough to accommodate the entire convention, thus avoiding the splitting up of the convention between two buildings as has been the case in past years. The desirability of holding occasional annual meetings of the society elsewhere than on the Atlantic seaboard has been recognized for some years, and for this reason Chicago was chosen for the 1931 convention.

The committee on papers and publications is at work on the development of the technical programs for the 1930 meeting. Plans are being developed for holding a symposium on aircraft material.



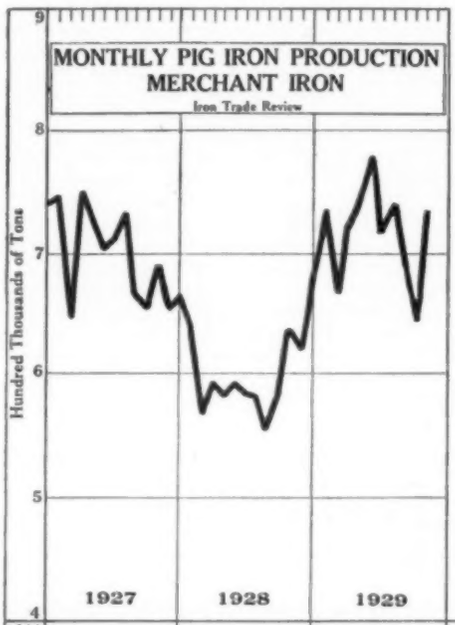
MACHINE IS BUILT FOR HEAVY DUTY WITH MAXIMUM PROTECTION TO THE OPERATOR

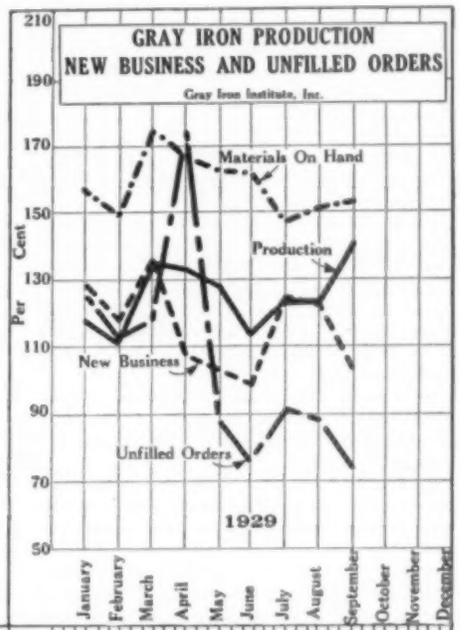
Trade Trends in Tabloid

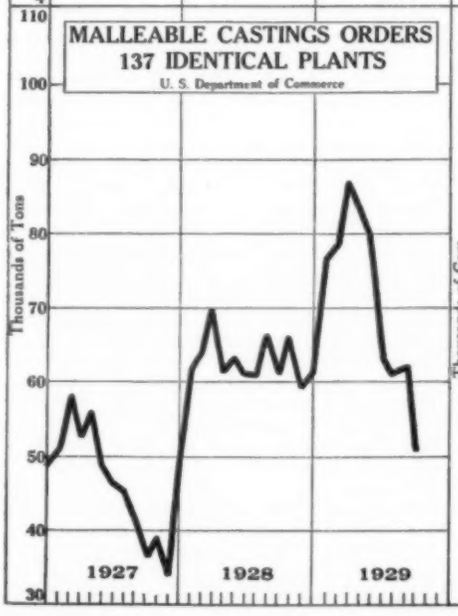
WINDING up a record year, the automotive industry has slackened production and a corresponding recession has overtaken many foundries specializing on this class of work. Malleable foundries, in particular, have been affected. However, with freight car orders in October approaching 20,000 units and a probable total of 100,000 cars in sight for the year, some of the slack has been taken up in both malleable and steel shops. Farm implement and electrical goods sales also have served as a shock absorber to compensate in a large measure for the decline in automotive lines. General jobbing gray iron business is good. While October production of all classes of pig iron declined slightly as compared with the previous month, according to *Iron Trade Review*, the total of merchant iron increased from 643,197 tons in September to 739,060 tons in October. The daily average rate on all classes of pig iron was 116,548 tons in September and 115,747 tons per day in October. Average New York daily prices of nonferrous metals, according to a compilation of *Daily Metal Trade*, were as follow: Casting copper, 17.452c; electrolytic copper, 18.00c; Straits tin, 42.301c; lead, 6.873c; antimony, 8.503c; aluminum, 23.90c. Zinc averaged 6.745c, E. St. Louis, Ill. Slightly lower trends are noted in prices of plumbing brass goods, while orders for sanitary ware declined.

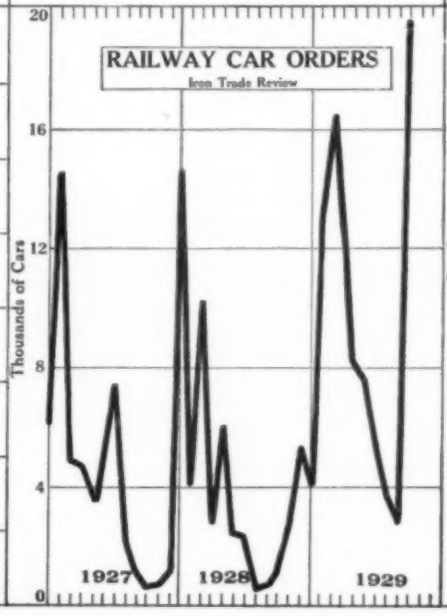
RAW MATERIAL PRICES
Nov. 7, 1929

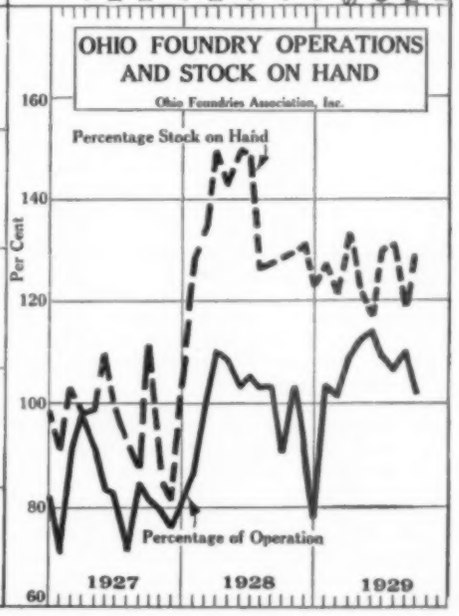
Iron	
No. 2 foundry, Valley	$18.50
No. 2 southern, Birmingham	14.50
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.76
No. 2 foundry, Buffalo	19.50
Basic, Valley	18.50
Basic, Buffalo	18.50
Malleable, Chicago	20.00
Malleable, Buffalo	20.00
Coke	
Connellsville beehive coke	$3.75 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.50 to 9.00
Scrap	
Heavy melting steel, Valley	$17.00 to 17.50
Heavy melting steel, Pitts.	16.50 to 17.50
Heavy melting steel, Chicago	13.50 to 14.00
Stove plate, Buffalo	12.50 to 12.75
Stove plate, Chicago	11.00 to 11.50
No. 1 cast, New York	12.50 to 13.00
No. 1 cast, Chicago	14.00 to 14.50
No. 1 cast, Philadelphia	16.00
No. 1 cast, Pittsburgh	15.00 to 16.00
No. 1 cast, Birmingham	14.00 to 15.50
Car wheels, iron, Pittsburgh	15.50 to 16.00
Car wheels, iron, Chicago	14.00 to 14.50
Railroad malleable, Chicago	16.50 to 17.00
Malleable, Buffalo	17.25 to 17.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	17.25
Electro, copper, producers	18.00 to 18.12½
Straits tin	39.62½
Lead, New York	6.35
Antimony, New York	8.37½ to 8.50
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	17.00 to 17.50
Zinc, East St. Louis, Ill.	6.50











What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Walker Mfg. Co., Fenton, Mich., suffered damage to its foundry by a recent fire.

Springfield Bronze Co., Springfield, Mass., has changed its name to Springfield Bronze & Aluminum Co.

French & Hecht Inc., Springfield, O., is improving its foundry and is installing additional equipment.

Leonard L. Burget and Steve Toth, Toledo, O., have leased the Paul Foundry plant, North Baltimore, O., for a five year period.

Nichols & Shepard Co., Battle Creek, Mich., has reopened its foundry after having been closed for about two months.

North Dighton Stove Co., North Dighton, Mass., which recently was destroyed by fire has gone out of business. (Noted July 15.)

Pressed Steel Car Co., Farmers Bank building, Pittsburgh, awarded contract for foundry additions to its plant at McKees Rocks, Pa.

National Motor Castings Co., South Haven, Mich., is constructing a plant addition, 40 x 240 feet, which will house sand handling equipment.

Fire recently damaged the plant of the Lakey Foundry & Machine Co., Muskegon, Mich. Loss may reach $50,000.

New Jersey Art Foundry, 433 Tonnele avenue, Jersey City, N. J., has awarded a contract for a one and 2-story foundry addition to Frank Crahay, 3572 Boulevard.

Lebanon Steel Foundry, Lebanon, Pa., has plans for the construction of a 1-story addition, 183 x 260 feet. Wilbur Watson & Associates, 4614 Prospect avenue, Cleveland, is architect.

Atlas Foundry Co., 3012 South Wilkeson street, Tacoma, Wash., has obtained a permit for a plant building to replace one recently damaged by fire.

Durox Steel Casting Co. Ltd., recently was incorporated to succeed the Durox Steel Corp., 688 Rio street, Los Angeles. C. D. Bonesteel is manager.

Ace Foundry Inc., 8240 South Aalameda street, Los Angeles, has made numerous improvements to its foundry including a new and larger core room.

Stanley S. Cramer, Copewood and Thorne streets, Camden, N. J., awarded a contract for a 1-story foundry, 40 x 80 feet, to C. L. Turner, 96 Kendall boulevard, Oaklyn.

Haynes Stellite Co., Kokomo, Ind., has been granted a permit for the construction of a foundry which will cost approximately $20,000. (Noted Oct. 1.)

Columbia Radiator Co., Walnut street, McKeesport, Pa., has a new building under consideration. It will be 100 x 140 feet and will contain a foundry, machine shop and warehouse.

American Brake Shoe & Foundry Co., 1179 East Thirty-second street, Los Angeles, has sketches for a proposed foundry at Maywood, Calif.

Miller Foundry Co., 730 Sheldon avenue, Columbus, O., has awarded a contract for an addition which will add 6000 square feet to the foundry, according to Edward Miller, president and general manager.

Industrial Pattern & Engineering Co., Muskegon Heights, Mich., has been incorporated with $50,000 capital by Edwin H. L. Englund, 924 Moffett street, to engage in general engineering and contracting.

Piston Ring Casting Inc., St. Louis, Henry Haacke president, has been organized for the manufacture of piston ring castings. Plans call for the employment of 80 men and 100,000 castings will be produced daily. Equipment and machinery investment represents $90,000.

Central Pattern Works Inc., Canton, O., has been incorporated with 250 shares of no par stock to manufacture and deal in patterns of all kinds, by Herbruck, Shetler, Molehier & Roach, Renkert building.

Tiffany Aluminum Products Co., St. Louis, has acquired a new plant building at Branch and Buchanan streets and will move its foundry and offices from the former location about Nov. 1. Lee Rosenberg is president.

Clay & Bailey Mfg. Co., 7007 East Fifteenth street, Kansas City, Mo., has acquired a site on Fortieth street including a building to be used as a foundry. Three buildings will be erected including machine shop, warehouse and cleaning room.

St. John Iron Works, Vulcan street, St. John, N. B., Canada, has awarded the contract for the reconstruction of the plant formerly occupied by the Union Foundry & Machine Works, Ltd. The building is 58 x 110 feet. G. H. Waring is manager of the St. John company.

Robert Mitchell Co. Ltd., 750 Belair avenue, Montreal, Que., has a foundry in the process of construction at St. Laurent, Que. The contract for the building has been let to Anglin-Norcross Ltd., 2063 Victoria street, Montreal and T. Pringle & Son, Montreal, has been appointed engineer of construction.

Negotiations for a merger between the Globe Stove & Range Works, Kokomo, Ind., and the American Steel Products Co., Macomb, Ill., are under way. When the merger is completed W. Dow Harvey, American Steel Products Co., will succeed Mark A. Brown as manager of the Globe company.

National Foundry & Furnace Repair Co., Dayton, O., which recently purchased a building at Springfield, O., from the American Radiator Co., is making preparations to open it as a branch. Equipment is to be purchased and will be installed as soon as possible, according to C. E. Davis, general manager.

Helgerson Foundry Co., Green Bay, Wis., which was bought several months ago by Wisconsin Foundries Inc., will be operated under the name of the latter company with production limited to gray iron castings. The Helgerson plant has been reconditioned and re-equipped and is in production in charge of S. J. Campbell. (Noted Oct. 15.)

Nutmeg Crucible Steel Co., Stony Creek, Conn., has let the contract for the construction of a new steel foundry, 70 x 103 feet, at Branford, Conn., to Leo F. Caproni & Co., New Haven, Conn. The approximate cost of the building will be $25,000. Equipment of the present plant at Stony Creek will be moved to the new location and no new equipment will be purchased.

Glancy Malleable Corp., Waukesha, Wis., is preparing to occupy its new foundry unit about Nov. 15. It will contain a new 30-ton melting furnace, with a 60-foot stack. A new shipping room will be ready about the time the furnace will go into operation. Other changes will be made so that the company may be ready Jan. 1 to start a new and larger program of manufacture. (Noted Aug. 15.)

Hurley Machine Co., Chicago, manufacturer of washing and ironing machines and electric appliances, will complete its expansion program soon with the operation of its new foundry unit, where cast gray iron and aluminum parts for electrical appliances will be produced. Approximately 50,000 additional square feet of floor space has been made available in the new structure. The company is a subsidiary of the Electric Household Utilities Co.

New Trade Publications

AIR TOOLS—Rotor Air Tool Co., Cleveland, O., has issued a folder showing the improvements recently made in its line of portable grinders.

ELECTRICAL EQUIPMENT—Electric Controller & Mfg. Co., Cleveland, has issued a folder describing and illustrating the use of its controllers, motor starters and compensators under adverse conditions.

ARC WELDERS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., describes its 300-ampere, gas-engine-driven, stationary or portable, single-operator, separately-excited welding machines in a recent folder. Application, specifications, dimensions and weights are discussed.

MATERIAL HANDLING—Cleveland Electric Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O., recently has issued a folder in which it discusses the value of its equipment in oven and dryer operation.

BLOWERS—The Connersville Blower Co., Connersville, Ind., tells of the principle of operation, power consumption, design and construction of its rotary positive blower in a current bulletin. Capacities, price lists and other data also are included in the bulletin.

MOTORS—General Electric Co., Schenectady, N. Y., has published two folders, one dealing with direct current, constant or adjustable speed, shunt or compound wound motors with either manual or magnetic control. The other supplies information on its totally enclosed, fan-cooled, continuous duty, two and three phase squirrel-cage motors of 1½ to 15 horsepower, 60 cycles, 220, 440 and 550 volts.

PUMPS—Barett, Haentjens & Co., Hazleton, Pa., has published an 8-page folder on its automatic pumping, suction-lift, centrifugal pump, with vacuum pump primer. It gives an explanation of systems used for this type of pump and gives a sketch to illustrate this. Explanations and diagrams show how several types of switches used in the hookup work. Descriptions and recommendations for the switches are included.

AIR COMPRESSORS—Chicago Pneumatic Tool Co., 6 East Forty-fourth street, New York, is issuing a 23-page bulletin of its power driven duplex air compressors. The details of construction are described and illustrated. Tables and illustrations give the specifications of the machines and several half-sections show the various parts of the compressors. Several photographs show typical installations. On the last page are illustrations and specifications of air receivers made by this company.